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## MEDICINE AS A CAREER[1]

*Students of Medicine:* You have chosen your life work. You have elected to devote your time and energy to the science and art of medicine. It is hoped that you fully realize the importance of this decision and that you have not come here without adequate deliberation and comprehension of the heavy tasks you have assumed in taking this step. In view of the possibility that some of you have made a mistake, I have decided to spend this hour in presenting to you a few of the duties and obligations which you are assuming and if there be among you those who feel that the burdens to be borne are too heavy and the personal gain too light, let such not hesitate to stop and turn back on the threshold. Medicine needs recruits, but it desires and will accept only those who, after severe tests, it deems worthy. I am aware of the fact that the words of the experienced fall lightly upon the ears of the inexperienced, but one who has served in the ranks for nearly forty years offers you advice. I wish to say that the fatality among medical students is great. In the past ten years, less than sixty per cent. of those who have entered this school have succeeded in winning its diploma, and of those who have gained this distinction not all have fulfilled the confidence imposed in them by the faculty. It is not my expectation that you will do better than preceding classes.

Medicine embraces all facts which may be utilized in the prevention or alleviation of diseases. Its chief contributory sci-

[1] Address at the opening of the University of Michigan Medical School, October 3, 1916.

ences are physics, chemistry and biology. It is for this reason that a knowledge of the fundamental principles and facts of these basic sciences is required for admission to the better medical schools. Some of you will fail because your training in these sciences has been inadequate. Teachers in the medical school can not take the time nor can they hold back better trained students to instruct those who are deficient. By the end of the first year most of these unfortunates are asked to withdraw.

With the best possible preparation the medical student finds his daily task quite as much as the strong can carry and altogether too heavy for the weakling. There has been some discussion among medical educators concerning the curriculum, some contending that it is too heavy for the average student. This depends upon what is meant by the "average student." If the standard set in college work is applied, I am of the opinion that medicine does not want such "average students." I am convinced that a strong student, of a high average, can carry the medical work as now imposed and that the imposition of a heavy task succeeds in weeding out the unfit and is therefore desirable. We do not develop muscles by lifting feather weights, nor do we strengthen brain activity without earnest effort. The aim of medical education is to develop strong men, and in order to do so difficult tasks must be imposed in the training.

A strong intellect is not enough to insure success to the medical student. Intellect must be backed by industry, otherwise it is of but little value. For lack of industry many medical students fall by the wayside. After forty years as a teacher in this school, I am of the opinion that lack of proper application to the work is the most potent cause of failure among the students. In his collegiate course the work has been light, easily done. He has had a good record, but has failed to establish habits of study. Some allurement causes him to neglect his tasks for a day and then for a week. Soon, he finds himself quite in the rear. His bluff at recitation does not go. His teachers question his intellectual strength and honesty. He becomes a derelict and must be removed for his own and others' good.

A third essential to success in medicine is integrity. When endowed with a high degree of intelligence, supported by the greatest industry but without integrity, the medical man is likely to prove a disgrace to his profession and a menace to the community in which he lives. That integrity has been regarded as an essential qualification of the practitioner of medicine from the earliest times is shown by the exaction of the Hippocratic oath supposed to have been formulated by the father of the profession. The medical man must be honest with himself, his patients and the public. For personal gain he must not pretend to greater knowledge or skill than he possesses. Professional ethics insist that in the announcement of his purpose to serve the community he must restrict himself to the simplest statement. The public has long ridiculed the restrictions which the medical profession has attempted, with more or less success, to impose upon its own members, but that the public is now reaching a point where it appreciates the righteousness of medical ethics is shown by recent legislation forbidding false and exaggerated advertisements. The first thing for the honest man in becoming a physician to do is to secure the best possible preparation. To enter upon the practise of medicine or to continue in it without adequate preparation is a crime—a moral, if not a statutory one. The public has come to this view and there is no other profession, admission to which is so strictly guarded as that of medicine. State laws set the stand-

ards of admission to medical schools and state licensing boards test medical graduates. The best intentions do not supply the deficiencies due to lack of knowledge and skill. It certainly can be said that in the practise of medicine knowledge is a virtue and ignorance a crime. Recognizing the fact that no man, however great his intelligence and untiring his industry, can be skilled in all branches of the healing art, individuals select specialties in which they strive to make themselves experts and these so group themselves that each patient may have the advice of an expert. The wisdom of this procedure and its advantages to both practitioner and patient must be evident to all. Each individual in such a group must know his specialty and must keep in touch with its progress. Medicine is a progressive science. Each year adds to its effectiveness. Discoveries in physics, chemistry and biology find practical application in the prevention or cure of disease. It follows that the efficient medical man must continue to be a student so long as he remains an active member of the profession. In medicine there are no "papal bulls" no "ipse dixits" and even "precedent" is shown but scant respect. It is best compared to a living plant constantly drawing sustenance from soil and air, dropping its withered leaves and branches, ever putting forth buds and blossoms and bearing each season better fruit. One who is not capable of sustained effort should seek some other calling in life. Occasionally I meet with men who are still living professionally in their undergraduate days, reading the same old books, and writing the same old prescriptions, both blind and deaf to the changed environment. Fortunately the more intelligent of the public easily recognize these fossils and appraise them at their true worth. They are interesting as relics of the past, but worthless in the present.

From the time of Hippocrates to the present, wise men in the profession have always advocated amity among its members and I must say after many years of personal experience that there is no other high professional ideal so difficult in realization, but I am proud to add that there never has been a time when the promise of the realization of this ideal has been so great as at present. In this matter medical men have learned much from the commercial world in which the value of cooperation has been so abundantly demonstrated. The efficiency of the individual has been increased and the value of the product has been improved. Much regret has been expressed concerning what is called the passing or the elimination of the old-time family physician or general practitioner. In the slow development of scientific medicine he served his fellow men, often with the greatest devotion and self-sacrifice. The history of epidemics shows him to have been often worthy of the highest honor. He has faithfully served his fellow men in times of dire distress. Occasionally he has made contributions of the greatest value to science. In the record of the slow progress of man from the marshes of ignorance and superstition to the uplands of knowledge and science he bears a conspicuous and honorable place, but in the practise of modern medicine his part is a subordinate one.

In any community in which several physicians are singly doing a general practise, cooperation, with the development into skilled specialists, results in individual efficiency among the medical men and better service to their clientele. With a properly equipped hospital at their service, a group of village physicians may give their patients the same scientific and effective treatment that they can secure in larger medical centers. I have no sympathy with the contention that our rural population de-

mands cheaply educated physicians. With trolley cars and automobiles there are but few in need of medical aid who are so located that a good physician may not soon reach them, or what is better, that they can not soon be transported to a hospital. A friend who has long practised in a small Montana city recently told me that twenty and more years ago his ride sometimes carried him one hundred and twenty-five miles from home. One such visit to a case of pneumonia is unsatisfactory to the doctor and of but little benefit to the sick man. Now, the automobile brings the patient to a well-equipped hospital where several physicians may daily consult concerning the case and trained nurses be constantly in attendance.

When I was in medical practise, like the milk man, I made my daily rounds, seeing cases of scarlet fever, diphtheria, sometimes smallpox, pneumonia, various nervous diseases, attending cases of labor and in short I was a general practitioner. Like others of the kind, I did the best I could for all and I am able to say with some pride that in no case did I carry infection from house to house. However, in order to avoid this I often had to change my clothing and disinfect my person many times in one day. This kind of practise is still largely in vogue, but it is gradually being displaced by hospital treatment in which specialists direct and trained nurses administer. The greatest need of practical medicine to-day is more and better equipped hospitals. With these the specialist and the skilled nurse will multiply and improve. Such hospitals should be supplied with thoroughly equipped and competently manned diagnostic laboratories which should serve not only curative but preventive medicine. Water and milk supplies should be examined daily and visiting nurses under the direction of a competent health officer should constantly patrol the community. Adjunct dispensaries which should serve as schools of instruction in baby feeding and care, child welfare, home sanitation and in everything pertaining to healthy living should supplement the community hospitals. When in addition to these agencies the people generally can be educated to see the benefits that would follow the periodic thorough examination of all in order to detect the first departure from the normal, then medicine will be able to render its highest service to mankind.

It must be evident that if these hopes are to materialize the practise of medicine must become more and more a state function. That the tendency is in this direction and that this should be encouraged for the public good are not matters of doubt in my mind. Only a few years ago some of the most eminent men in the profession combated earnestly state support of medical education. They claimed that the state had no right to establish and maintain medical schools and that such aid was not fair in competition with the proprietary schools, which at that time educated more than ninety per cent. of the annual recruits to the profession. Now, no one questions either the right or the duty of the state to establish and support medical schools, while the proprietary schools, having proved wholly inadequate and inefficient, have practically ceased to exist. Even the man in the street sees the advantages that have resulted from these changes. To state that a medical school is a proprietary one, in the sense generally understood by that term, immediately condemns it with intelligent men. Courts from the lowest to the highest in the land have uniformly held that the state has the right to maintain its own medical school, also to pass upon the merits of other schools both within and without its borders, to set up standards

of medical education, to define the requirements of admission to medical schools, to submit those who wish to practise within its borders to certain intellectual and moral tests in order to pass upon their professional fitness and to revoke the licenses of the unworthy. The federal government has its public health service which passes upon immigrants, controls national quarantine, maintains a research laboratory, supervises the manufacture and sale of vaccines and antitoxins, and stands ready to aid any state in combating epidemics. Each state has its board of health, the powers, functions and efficiency of which vary widely. Our great municipalities have their boards of health and commissioners of health which for the most part are efficient, but in some instances are parts of a political machine. Our smaller cities and rural communities have their boards and health officers, which with some notable exceptions, fortunately in increasing numbers, are cheap, ignorant and inefficient.

By means of these organizations, imperfect as many of them are, the death rate in the registered area of the United States has been reduced in the past thirty years from twenty to fourteen per thousand, the average life has been increased more than ten years, and the mortality from tuberculosis and other infectious diseases has been reduced about fifty per cent. On account of the greater efficiency of the health service in our larger cities, the reduction in the death rate has been more marked in these than in smaller cities and rural communities. The greatest reduction in mortality has been secured in our cities of one hundred thousand or more. Our metropolis, New York, has a municipal health service which is second to none in the world. It supports a research laboratory in which the highest grade of scientific investigation is done, diagnostic laboratories in which diphtheria cultures, suspected sputum, blood examination and other tests essential to scientific medicine are made and laboratories in which water and food supplies are carefully guarded. It has a corps of expert diagnosticians ready to aid the practitioner in all suspected cases, free of charge to either the medical man or the patient. It provides medical-school inspectors who detect infection in its earliest stages, excellent hospitals in which the sick have the best care and treatment and nurses who patrol the tenements and other homes of the poor and give instruction in sanitation. It examines cooks and waiters to see that none of these may distribute typhoid fever, tuberculosis, syphilis or other infections. It inspects meat markets, bakeries, milk stations and other places of food supply and has the authority to close these when unsanitary conditions are found.

The last legislature of Michigan made an appropriation of one hundred thousand dollars and directed the state board of health to expend it in attempts to restrict tuberculosis. Several thousand citizens have already been examined free of charge in order that this disease may be detected in its early stages when it is amenable to hygienic treatment. These people are not only examined but those found infected are instructed how to live in order to avert the progress of the disease.

I have chosen to bring these matters before you in order to impress upon you the relation which the profession, which you have selected, bears to the public. Even the physician who devotes himself wholly to what is known as private practise does not escape his duties to the public. He is morally bound not only to do his full duty to the individual who employs him, but to protect the community. You have chosen to come to a school supported by the state.

Michigan practically gives you your education. Why does it do this and what does it demand of you in return for this great gift? It expects that you possess intelligence, for without this the gift is valueless; that you manifest industry both during and after your student life, for without this you bury your talent; that in all your actions, both professional and nonprofessional, you show the most sincere integrity, for without this you become a menace to your benefactor. The state has selected this faculty to ascertain to what extent each of you possesses these essential qualifications and I can assure you that those found wanting will not find their way into the profession through these doors. To those who prove worthy, every reasonable encouragement and proper assistance will be given.

I am sometimes asked what financial reward can the medical man reasonably expect? This is a proper question and I am ready to give it my answer. In the first place, a medical education, even with the relatively small tuition one pays in a state university, is the most expensive professional education, both in time and money, both to the state and to the student.

The laboratory expenses of the medical student are higher than those in any other school. Where other students buy books, he buys not only more expensive books, but he must also purchase a microscope, blood counter, and other expensive instruments. After graduation most medical students spend from one to three years in hospital work and at least one of these promises soon to become obligatory on all. When he begins practise the medical man must have a respectable office and a well-equipped laboratory. He must continue to buy expensive books, for the average medical book is out of date almost as soon as it leaves the press, so rapid has been the advance in scientific medicine in the past thirty years. He can not do without the best professional journals, and, being a member of a learned profession, he is ashamed to be ignorant of the best general literature. In his consulting room, his visits to the homes of his patient and in his association with his fellows he must be neatly, though he need not be expensively, dressed. He must supply himself with means for quick and comfortable travel. Without going into further particulars I may say that by the time he is ready to begin his professional work the most economical medical man has already made an investment of from ten to twenty thousand dollars, counting his actual expenses, allowing a fair amount for his time and calculating the interest on these amounts, and when he begins he must have the wherewithal to make his work successful. No medical man can neglect the financial side of his life's work. Without an adequate income he can not reach a high degree of efficiency in his work. However, the medical man who is imbued with the right spirit will use his financial gains largely in increasing his professional efficiency. After setting aside enough for the fair support of himself and those dependent upon him, he will devote the surplus —and there must be a surplus if he is to be successful—to better equipment, both physically and mentally. It has been my observation that the more intelligent laity respects the physician who endeavors to keep himself well posted and well equipped in his professional work. Medical men who attend their local, state and national societies are, as a rule, successful financially, while those who think that they can not leave their work even for self-improvement have a hard time in making ends meet. One who wishes to accumulate a fortune, or to become wealthy as that term is now understood, should choose some other call-

ing. I know of no one who has placed himself in this class by the reputable practise of medicine. Some medical men have made riches by fortunate investments, but this is an exception. Some marry wealth, but this is usually fatal to professional efficiency. I know of but one man who has demonstrated his ability by winning the highest distinctions in the profession notwithstanding the fact that he married a wealthy woman. While on this point, I may say that practise coming from the ultra rich is not to be coveted. They are exacting in their demands for service. They object to ordinary bills and cry out that they are being sandbagged. As I write this, I have before me such a letter from a millionaire. He admits that he selected the medical man on account of his recognized skill, that he knew what the charges would be before the services were closed and that he did not object at that time, because he was afraid that the medical man would desert him, but when payment was demanded, he claimed that he was being sandbagged because he was known to be rich. The ultra rich are familiar with the use of the sandbag in extorting money from others and they see its phantom in even the most moderate bills presented them.

The medical practitioner endowed with intelligence, fortified with industry and with his every action controlled by strict integrity is sure to make a decent living, care for himself and family in comfort and he need not sleep in a pauper's grave. He is not compelled to sacrifice his self-respect to expediency. His calling is quite as independent as any other. He can choose his own friends, church and political affiliation. The man who is sick with pneumonia or has an inflamed appendix does not consult the society columns, the church directory nor the polling lists when he selects his medical attendant. He prefers the man who is likely to render him the best service, and the intelligent public in the long run and on the whole judges wisely. There never has been a time when individual worth among medical practitioners was more correctly evaluated and, I may add, more highly estimated, than the present. Medicine has cast off the veil of mystery which once covered her face and walks among men uncovered and unashamed. The days of "divine healers," Indian medicine fakirs, and of Mrs. Winslow and Lydia Pinkham, are passing away. Some may say that these statements are contradicted by the wide prevalence of christian science, osteopathy and other cults. These are only the vagaries which have taken form in the delirium-racked brain of a fast-dying superstition. Did our government select any of these agencies in its successful combat with yellow fever in Cuba or on the Canal Zone? Has it relied upon them to keep Asiatic cholera or the plague out of this country? Did it send christian scientists or osteopaths to stay the epidemic threatened by the Dayton floods? Are these cults now busy healing the wounds and adjusting the dislocated bones so abundant on European battlefields? Our Lady of Lourdes and Ste. Anne Beauprie are apparently not on duty at a time when shell-torn and flame-tortured humanity is in greatest need of their much extolled, miraculous powers of healing. The genuine worth of scientific medicine has never been so thoroughly tested as in the present war. Amid unprecedented difficulties, in the camps where millions are congregated, in the quick transportation of corps after corps, in the trenches and even among the prisoners of war, always cared for grudgingly and reluctantly, everywhere, preventive medicine has successfully met her old foes, typhoid fever, dysentery, cholera, tetanus and other epidemics, which in

former wars have usually been the most destructive factors in the midst of contending armies, and have often decided battles and determined the fate of nations. Decisive victories have not yet followed the flags of the central or the allied armies, but in all the red cross signalizes the most triumphant achievement of man. International laws have been torn into shreds and become mere scraps of paper, moral and religious precepts and codes have been supplanted by brutalities never practised by primitive man and the foundations of civilization have seemed to be on the point of disruption and final collapse, but the spirit and ideals of scientific medicine remain unsullied and a new world in which these shall dominate will be created.

Medicine offers a number and variety of special activities to those who choose it as a career. First, there is the grand division into preventive and curative. The former is a product of the nineteenth century, the latter as old as the records of man. The oldest and still a widely dominant theory, as to the cause of disease is that it is an infliction laid upon man by some supernatural being. Primitive man, which term once embraced all, and in this particular, still includes many, probably a majority, even among the most highly cultured nations, believed in the existence of powerful spirits, who measured out good and ill to individuals as their own will might indicate. The religion of such believers consisted and still consists in attempts to propitiate these powerful, or one omnipotent, spirit. They built and still build altars of sacrifice and temples of devotion in which they proclaim their own weakness and implore divine protection and guidance. They still beseech a supreme ruler to shower blessings upon themselves and curses upon their enemies. In the hands of the Jehovah of the Jews disease was a scourge for the punishment of those who merited his displeasure. In the adoption and modification of the Hebrew religion by the Christian world, the idea of a God of wrath was adopted, and still prevails. Even to-day in battle-scarred Europe, the same God is invoked and his aid asked in each contending army. With this inborn superstition transmitted through countless generations, scientific medicine has had to contend. The combat has extended through centuries, as is shown by the earliest records of human achievement. The first signal victory was won when Jenner robbed smallpox of its horrors by the discovery of vaccination and success was assured by the labors of Louis Pasteur who marked the way by which each infection may be identified, controlled and abated.

An enlightened public is beginning to recognize that many diseases, especially the infections, are preventable and the medical profession is being called upon to plan and direct this work. Many of the smaller cities and some rural communities are providing for full-time health commissioners and the demand is greater than the supply. This and other universities are conducting courses specially suitable for public health officials. I am sure that some of you will select this field for the development of your life work. In it there is abundant opportunity to do credit to yourself while you serve the highest interests of your fellow man. The labors of Reed and his colleagues demonstrated the agencies by which yellow fever is spread, and Gorgas and his helpers freed Cuba from this disease and won a greater triumph in the Canal Zone. Laveran and Ross did even a greater service in showing how the world may free itself from malaria, which in all times has held some of the fairest and most fruitful lands under its curse. Preventive medicine is now capable of opening up the tropics as

suitable habitations for civilized man, of removing the stigma of being the "home and nursery of disease" from the fertile valleys of the Nile and of returning to cultivation the banks of the Euphrates and the Tigris on which the cradle of civilization was rocked. I can not believe that coming generations will be so insane as not to use this most potent agent in reclaiming the marsh, the wilderness and the barrens, and converting them into fields, rich in agricultural products and abundant in happy homes. Man's destiny is in his own hands and he may make of this earth a heaven of peace, plenty and prosperity, or he may mar it into a hell of strife, rapine and murder. In knowledge he has advanced to a position in which he becomes a co-worker with the Creator and he must bear the responsibilities which such power imposes. In the struggle between good and evil, knowledge and ignorance, science and superstition, medicine has, and must continue, to lead the way, and you as its standard bearers must serve your day and generation with intelligence, industry and integrity. I do not mean that you are to do your work, always conscious of the burden of duty. With all its imperfections this life is worth living and its highest joys lie in its contests. The man who does not get real pleasure out of his work remains a poor workman and his products do not find ready sale in the market. Even the bitterest disappointment, when you have done your best, often becomes a beacon light warning you of the rocks and leading you into a safe harbor.

It must not be inferred from the great stress that I have placed upon preventive medicine that the curative art is not equally worthy. Moreover, cure is not going to be replaced wholly by prevention. Disease and accident will continue so long as man reproduces his kind. The history of this, the older, branch of medicine is that of man's efforts to relieve the distress and to minister to the needs of his fellow man. Born in ignorance, nourished on superstition, clothed with mysterious rites and ceremonies, medicine has had a hard task to free itself from hereditary and environmental influences. Attempts to break away from these adverse and retarding conditions has marked the highest efforts of the race. During nearly every century since recorded history began, there have been some superior men, intelligent and far-seeing above the masses, who have contributed something to science. Such were Hippocrates, Galen, Pare, Servetus, Harvey and others whom we now delight to honor as contributors to knowledge and benefactors to the race. The discoveries, by empirical methods, of the specific effects of Peruvian bark in malaria and of mercury in syphilis did much to improve the condition of life and to enlarge the field of human endeavor. Since the scientific era began, the marvelous virtue of antitoxin in diphtheria; its great value in tetanus; the relief of cretinism by thyroid feeding; the action of thymol in hookworm disease; the benefit of salvarsan in the treatment of syphilis; the Pasteur treatment of hydrophobia; the prevention and cure of beri-beri by nutritional regulation—mark some of the most evident achievements in curative medicine. For diagnostic and prognostic purposes the medicine man of primitive peoples consulted oracles, watched the peristaltic movements of the intestines of animals offered in sacrifice, or read the fate of his patient in the positions of the stars. The physician of to-day employs the discoveries in physics, chemistry and biology for these purposes. The physician of fifty years ago was compelled to rely largely upon the study and interpretation of symptoms in which the best became highly proficient,

to-day he supplements these studies with the microscope, Roentgen ray, test tube, and other instruments of scientific precision. Then, his conclusions were drawn largely from guesses, now they are founded upon exact and positive knowledge. A large part of your undergraduate education will consist in familiarizing yourselves with the use and application of instruments of precision for diagnostic purposes. Each year brings forth advances in the fundamental sciences and medicine is ever ready to utilize such discoveries as may be of service in the prevention or cure of disease. It has been demonstrated that the physiological action and therapeutical effects of a chemical compound can be modified by changes in its molecular structure. The genius of Ehrlich produced salvarsan and its later substitutes in accordance with this principle, and the possibility of finding curative agents in other diseases by similar investigations is now occupying the time and energy of many laboratory students. While the achievements of preventive medicine have greatly reduced the numbers of those infected, medicine is not neglecting its curative agents and we can confidently expect great results in this direction.

The advance of modern surgery has been marvelous. No greater gifts has science brought to suffering man than surgical anesthesia, the discovery of which American medicine can justly boast, and aseptic surgery, made possible by the fundamental work of Pasteur and given practical application through the genius of Lister. These discoveries enable the surgeon to penetrate every part of the body and remove diseased tissue, repair injuries, extract foreign bodies and restore the individual to health and efficiency while he sleeps wholly unconscious of the operation. Plastic surgery has become a fine art and the successful transplantation of tissue is being practised in the base hospitals of Europe, where the brutalities of man are being ameliorated by skilful operation. The possibility of not only preserving but of growing animal tissue *in vitro* has been demonstrated and has developed a reasonable hope that the surgeon of the future may do still greater miracles.

The development of medicine must be preceded by scientific discovery, because medicine consists in the application of these discoveries. It follows that the highest duty of the medical man is to make contributions to scientific advances. In the past medical men have made an honorable record in this direction and there is no branch of science to which they have not brought valuable contributions. Even at the present, the open field of knowledge is of small dimensions, while on every side extends the boundless wilderness of ignorance. It has been a great privilege and a joy to have lived at a time when my chosen profession has been so rapidly moving forward and to have met face to face so many of its leaders. It has been my fortunate lot to work in the laboratory of that great German, Koch, to have listened to the words of that great Englishman, Lister, to have enjoyed the friendship of that great Russian, Metchnikoff and to have looked into the kindly face of the greatest man of the generation, if greatness be measured by good done one's race, that Frenchman, Pasteur. May some spark of the genius which led these men to great accomplishments descend upon and abide in you.

V. C. Vaughan

## KEITH LUCAS

In the death of Keith Lucas on October 5, 1916, physiology suffered the loss of a really great investigator. At thirty-seven years of age he and his junior co-workers had already, as I see it, thrown more light on the fundamental functional properties of the excitable

tissues, nerve and muscle, than has been thrown by the combined efforts of all other investigators; and the possibilities of future achievement, had he lived, are altogether incalculable.

The great majority of his published writings have appeared in the *Journal of Physiology* and most of them reveal a common trend of thought. Although to appreciate the full meaning of this work and the brilliance of the experimentation one must read his papers, still it is possible to get some idea of his contribution from the Croonian Lecture in which in 1912 he summarized the results of his researches up to that date. In that lecture entitled "The Process of Excitation in Nerve and Muscle"[1] a comprehensive survey of crucial experiments brings out the broader meaning of his investigations, and shows the essential unity of the apparently diverse aspects of the subject with which he dealt.

We owe to him the first clear picture of the sequence of events involved in the phenomena hitherto loosely grouped under the term "excitation." He showed the great importance of the "local excitatory process" which is the immediate consequence of the external stimulus and which must be clearly distinguished from the "propagated disturbance" to which, if sufficiently intense, it gives rise. By a careful quantitative study of the "summation of inadequate stimuli" and of the time factor in the exciting electric current he laid the foundation for the completion of Nernst's hypothesis of excitation by Hill and for his own quantitative verification of the hypothesis in its modified form. With his characteristic modesty and sense of the limitations of our knowledge he claims for this verification only a "guide to the strengthening of our experimental data"; but to one less conversant than he was with the difficulties in the way of drawing final conclusions, it would seem that he had presented an excellent case for the conclusion that the local excitatory process is a concentration of ions at some point within the tissue.

In his more recent researches his attention has been given less to the nature of the local excitatory process and more to the properties of the "propagated disturbance" which results only when the former process reaches adequate intensity, and which is manifested by the electrical response and the refractory phase. Among these later papers is one which seems to me his most characteristic and brilliant work, the elucidation of the "apparent inhibition" of Wedensky.[2] The way in which this baffling phenomenon is dissected and explained step by step by means of exquisite and crucial experiments makes it the most perfect piece of scientific work I know of. Every experiment is so designed as to be crucial, to give unequivocally the answer to the question at hand; and the clarity with which difficult and complex ideas are expressed reveals an extraordinary gift of exposition.

In experimentation it was his most salient trait to devote his energies wholly to what really counted in yielding the result. He made most of his apparatus with his own hands, and he never wasted a minute trying to make it look neat; perfect working was the sole aim. To furnish uniform motion of his photographic plate a discarded motor-bicycle cylinder was filled with oil and a hole drilled in the piston-head through which the escaping of the oil regulated the speed with an accuracy which sufficed for the most refined quantitative determinations. A sense of proportion characterized all his work. He never wasted effort in securing refinement and accuracy in one part of an experiment which would be nullified by unavoidable errors in another.

The fruits of his work are not measured merely by his own published writings, for Adrian, trained by him in thought and in experimental technique, has followed out some of the ideas suggested by his researches with consummate success. Thus he has established the "all-or-none" law for the nerve impulse; and the far-reaching consequences in physiology of this achievement are expressed in a letter by Professor Sherrington:

> All or nothing as a principle of nerve-fiber response seems to me as to you established. It must

[1] *Proc. Roy. Soc.*, Vol. 85, *B*, p. 495.

[2] *Jour. Physiol.*, Vol. 43, p. 46.

appear as a new datum for whatever schemata we offer of central mechanisms. The data for such schemata have been so few that the diagrams were easy to make but not of much significance. The new ones if less easy to sketch will have more meaning.

Lucas had little patience with unfounded speculation or with the elaboration of hypotheses without any attempt to test them. But that his thoughts were not limited to the direct results of his experiments is shown by his cautious but suggestive remarks on the possible application of his analysis of the Wedensky effect to inhibition in the central nervous system, and again on the possible basis for an explanation of reflex summation. His attitude is expressed in these words:

> There is a tendency to attribute to the central neurone and its connections properties which have no basis in the direct observation of the simple conducting tissues. It is our belief that the time for such a procedure can only come when it has been proved after repeated trial that there is no explanation of central phenomena possible in terms of properties revealed by the study of the simple tissues.

His sense of the immensity of the problems which drew him on is shown in the conclusion of his Croonian Lecture, in which he remarks "we may now claim to have passed through the first phase of ignorance, in which we merely admitted that we did not know, and to have reached the second phase of ignorance, in which we are recognizing what precisely are the points on which our want of knowledge is most profound." The breadth of his outlook on physiology is shown in two stimulating articles on "The Evolution of Animal Function" published in 1909 in *Science Progress*.

Thus he was a scientist combining rare mechanical ingenuity and experimental skill of the highest order with a wonderful grasp of the crucial tests through which advance should come and a broad philosophical view of the truths he brought to light. But besides all this he was a man of great personal charm and nobility of character. His keen and delightful sense of humor and his modest, friendly personality made him a companion and friend beloved by those about him.

The spirit in which he left his absorbing career to play his part in the great fight for liberty is reflected in a letter written in the spring of 1915, an extract of which appears in the *Atlantic Monthly* for October, 1916 (page 546). He was to have joined an artillery company, but on the very day he was to have been sworn in he was sent for to carry on research at the Royal Aircraft Factory on devices for the control of aeroplanes. He had already perfected an aeroplane compass and was engaged in similar experimental work when he met his death in a flying accident.

Alexander Forbes
Harvard Medical School

## INDUSTRIAL RESEARCH IN CANADA

The Canadian government has appointed an honorary advisory council on scientific and industrial research to advise a committee of the cabinet consisting of the ministers of trade and commerce, interior, mines, inland revenue, labor and agriculture, on all matters relating to the extension and coordination of scientific and industrial research, with a view to securing united effort and mutual cooperation between scientific workers and industrial concerns, and to selecting the most practical and pressing problems indicated by the industrial necessities for submittal to research and other institutions and individuals for solution.

The members of this advisory council are: Dr. A. Stanley Mackenzie, president of Dalhousie University, Halifax, N. S.; Dr. Frank D. Adams, dean of the faculty of applied science, McGill University; Dr. R. F. Ruttan, professor of chemistry, McGill University, Montreal; Dr. J. C. McLennan, director of the Physical Laboratories, University of Toronto; Dr. A. B. Macallum, president of the Royal Society of Canada, University of Toronto; Dr. Walker Murray, president of the University of Saskatchewan, Saskatoon; Mr. Robert Hobson, president of the Steel Company of Canada, Hamilton, Ont.; Mr. R. G. Ross, consulting electrical engineer, Montreal; and Tancrede Bienvenu, manager of La Banque Provinciale, Montreal.

The question of the cooperation of the scientific men and laboratories of the country with the industrial concerns with a view to solving

the problems raised by the war and to placing the industrial resources of the country in a position to meet the conditions that will arise after the war has been under consideration by the government and by representatives of science and industry for some time, as it was felt that it was more desirable to follow the example of the British government in this matter.

The question was fully discussed at the meetings of the Royal Society of Canada in May, 1916, and a deputation of this society waited upon the Honorable Sir George E. Foster, minister of trade and commerce, and the Honorable Sir Thomas White, minister of finance, to place the services of the society at the disposal of the government and to recommend the appointment of an advisory committee for the furtherance of industrial research. The matter had already been considered by the minister of trade and commerce and action was promised.

Sir George Foster held a number of conferences with representative men of science and industry, and as a result of his report to the government definite action was decided upon in June by order-in-council. In his memorandum he pointed out "the urgent need of organizing, mobilizing and economizing the existing resources of scientific and industrial research in Canada with the purpose of utilizing waste products, discovering new processes —mechanical, chemical and metallurgical— and developing into useful adjuncts to industry and commerce the unused natural resources of Canada."

## SCIENTIFIC NOTES AND NEWS

THE president and council of the Royal Society have made the following awards: A Royal Medal to Dr. John Scott Haldane, F.R.S., for his services to chemical physiology, more especially in reference to the chemical changes of respiration. A Royal Medal to Professor Hector Munro Macdonald, F.R.S., for his contributions to mathematical physics. The Copley Medal to Sir James Dewar, F.R.S., for his investigations in physical chemistry, and more especially his researches on the liquefaction of gases. The Rumford Medal to Professor William Henry Bragg, F.R.S., for his researches in X-ray radiation. The Davy Medal to M. le Prof. Henri Louis le Chatelier, For.Mem.R.S., for his researches in chemistry. The Darwin Medal to Professor Yves Delage, for his researches in zoology and botany. The Sylvester Medal to M. Jean Gaston Darboux, For.Mem.R.S., for his contributions to mathematical science. The Hughes Medal to Professor Elihu Thomson for his researches in experimental electricity.

THE Stockholm correspondent of the *Morning Post*, as quoted in *Nature*, states that the Nobel prize for physiology for 1916 will probably be awarded to Professor H. J. Hamburger, of Groningen University. It is stated that the Swedish Academy of Sciences has decided not to award this year the Nobel prizes for physics and chemistry.

PRESENT and former students of Professor E. B. Wilson will give a dinner in his honor in New York on the evening of December 28. Former students of Professor Wilson, whether at Columbia or elsewhere, who have failed to receive an announcement of the dinner, can obtain full particulars by addressing Professor Gary N. Calkins, Columbia University.

PROFESSOR S. A. MITCHELL, director of the Leander McCormick Observatory of the University of Virginia, has been appointed by Columbia University special Ernest Kempton Adams research fellow for a period of five years. This award comes as an extension of the regular Adams fellowship held by Professor Mitchell for the years 1914–16. The research undertaken was the determination of the parallaxes of the fixed stars by photography with the 26-inch McCormick refractor. Already the distances of one hundred stars have been determined.

OWING to ill health, Mr. H. W. Henshaw has resigned his position as chief of the Bureau of Biological Survey, Department of Agriculture, dating from December 1. Mr. Henshaw has been connected with the Department of Agriculture since 1905, serving as assistant chief of the bureau until 1910, and

then as chief. During this period the survey has grown rapidly. In order that the bureau may continue to have the benefit of Mr. Henshaw's knowledge and experience he will retain official connection with it as consulting biologist. Mr. E. W. Nelson, who has been on the scientific staff of the bureau since 1890 and assistant chief since 1914, has been appointed to succeed Mr. Henshaw as chief of the bureau.

As has been already noted in Science, meetings of the Geological Society of America and the American Paleontological Society will be held in the Education Building, Albany, on December 27, 28 and 29. The address of the president of the Geological Society, Dr. John M. Clarke, is on "The Philosophy of Geology and the Order of Research." That of the president of the Paleontological Society, Dr. Rudolf Ruedemann, is on "Persistent Paleontological Types." There will be public addresses by Dr. George Otis Smith, director of the U. S. Geological Survey, on "Geology and Public Service," and by Professor Richard S. Lull, of Yale University, on "The Pulse of Life." There will be symposia on "The Geology of Petroleum" and on "The Interpretation of Sedimentary Rocks."

The Section of Agriculture of the American Association for the Advancement of Science will hold its session on the afternoon of December 27, at 2 o'clock, in the Brinckerhoff Theater, Barnard College, Columbia University. At this session the address of the retiring vice-president of the section, Dean Eugene Davenport, of the University of Illinois, will be delivered on the subject of "The Outlook for Agriculture." The subject will be further considered in a symposium on the general topic of "The Adjustment of Science to Practise in Agriculture." This will be presented under the following four heads: (1) Some Factors lying between Scientific Results and the Farm, by Dr. H. J. Wheeler, of Boston; (2) Limitations of Science to Progress in Agriculture, by Dr. J. G. Lipman, director of the New Jersey Experiment Stations; (3) Economic Factors as affecting the Applications of Science, by Dr. G. F. Warren, of the College of Agriculture at Cornell University; and (4) Regional conditions as determining the Type of Agricultural Inquiry, by Director B. Youngblood, of the Texas Experiment Station. The divisions of the subject will be treated in a semi-popular manner, rather than in their strictly technical aspects, and the discussion will not be restricted to any particular department of agricultural science. The purpose is to make the program one of general interest. There will be opportunity for free discussion.

Through the courtesy of the American Museum of Natural History and in connection with the convocation week meetings (December 26–30) of the American Association for the Advancement of Science, the New York sections of the American Chemical Society, chairman, Dr. J. Merritt Matthews; The American Electrochemical Society, chairman, Dr. G. Colin Fink; The Society of Chemical Industry, chairman, Dr. Jerome Alexander; and The Museums of the Peaceful Arts, acting president, Dr. George F. Kunz, are planning an exhibition on preparedness, to be shown on the fourth floor of the museum building. The exhibit will consist of a set of the native elements belonging to the American Museum of Natural History; a collection of all the known elements; electrochemical products, nitrogen products from the air; coal-tar derivatives; and explosives—the new chemistry of preparedness developed during the past two years. The exhibit will be shown during the convocation week and for one month thereafter to the public. Dr. George F. Kunz is chairman of the exhibition committee. Scientific research will be shown in a special exhibit dealing with the life and work of Pasteur. Letters, manuscripts, pictures or other memorabilia which might be of interest in this connection are greatly desired for this purpose. Any one having material that would add to the Pasteur exhibit is requested to communicate with Professor C.-E. A. Winslow, curator of public health, American Museum of Natural History, 77th Street and Central Park West, New York City, who is chairman of this special branch of the committee.

AN expedition in the interests of the Smithsonian Institution will leave shortly for the French Congo and certain of the neighboring parts of West Africa. It will be known as the "Collins-Garner Congo Expedition, in the Interests of the Smithsonian Institution," and will be headed by Mr. Alfred M. Collins, of Philadelphia, a well-known explorer and sportsman, who has made several trips to Africa and other regions in search of big game. Richard L. Garner, of New York, who has already made extensive investigations concerning the apes and monkeys of Central Africa, is manager of the expedition. The other members of the party are: Professor Charles W. Furlong, of Boston, scientist, artist and explorer, and Mr. Charles R. W. Aschemeier, of Washington, who represents the Smithsonian Institution as collector of natural history specimens for the United States National Museum. It is expected that Mr. Garner and Mr. Aschemeier will start for Bordeaux as soon as the outfit is ready, probably on December 9, and that Mr. Collins and Professor Furlong will follow about March 1, 1917.

THE London *Times* states that a survey party, led by the geologists Messrs. Talbot and Clarke, has been attacked by blacks between Laverton and Warburton ranges, western Australia. Mr. Johnstone, a member of the party, received a severe spear wound in the thigh, and Mr. Talbot was speared through the arm.

DR. R. RUGGLES GATES, who had planned to spend the winter in research work at the New York Botanical Garden, has decided to return shortly to England to enlist in the British army.

MR. F. A. MCLAUGHLIN, instructor in botany at the Massachusetts Agricultural College, has been granted a year's leave of absence for graduate study at the University of Chicago.

THE Botanical Society of Washington has elected the following officers for the ensuing year: *President,* Mr. T. H. Kearney; *Vice-president,* Mr. Edgar L. Brown; *Recording Secretary,* Mr. Charles E. Chambliss; *Corresponding Secretary,* Dr. H. L. Shantz; *Treasurer,* Mr. F. R. Farrell. Mr. A. S. Hitchcock was nominated by the society for the position of vice-president of the Washington Academy of Sciences.

THE Anthropological Society of Philadelphia has resumed its regular meetings for its fourth year, with Dr. W. Max Müller as president and Mr. E. P. Wilkins as secretary. The society now has twenty members, as follows: R. T. Aitken, G. Annear, B. S. Brumbaugh, D. W. Berkey, E. Chiera, Wm. Churchill, M. M. Dorizas, F. Edgerton, R. H. Ferris, E. W. Hawkes, W. W. Hyde, H. D. Jones, J. E. Mason, W. Max Müller, L. E. Sabary, W. H. Schoff, F. G. Speck, R. J. Weitlaner, E. P. Wilkins, S. Williams. The first meeting of the year was held on November 18, Dr. Müller presenting a paper on "The Humorous Experiences of an Africanist."

PROFESSOR JOHN M. COULTER, of the University of Chicago, lectured in the Sigma Xi circuit, including the universities of Kansas and Missouri, from November 13–16. Two lectures were given at each university, the titles being "The Ideals of Science," and "Inheritance and Response."

DR. RICHARD C. CABOT, of Boston, is giving a series of lectures under the auspices of the Social Service Corporation of Baltimore, on "The Social Aspects of Public Health Work in the United States," including industrial, educational, moral and religious and governmental aspects.

PROFESSOR HEINRICH RIES, of the department of geology, Cornell University, is giving a course of ten lectures on non-metallic products in the course on economic geology at Columbia University.

THE College of Liberal Arts and Sciences of the University of Illinois has announced a series of assemblies for 1916–17 that will consider recent developments in science. On last Thursday evening the first of these was held, at which Professor Joel Stebbins spoke on "Measuring the Light of Stars." The second will be held on December 14, the speaker of the occasion being Professor Jacob Kunz, who will speak on "Recent Light on the Ultimate Constitution of Matter." The third, January 11,

will be addressed by Professor R. C. Tolman on "The Theory of Relativity." The fourth, February 15, will be addressed by Professor C. S. Hottes on "Some Recent Advances in the Physiology of the Cell" and the fifth on March 15, will be addressed by Professor G. M. Whipple on "Recent Development in Mental Testing." The speakers are all from the University of Illinois.

The following lectures were recently given at Oberlin College, under the auspices of the department of zoology: "The Maturation and Fertilization of the Eggs of *Nereis*," by Dr. Omer Van der Stricht, of the University of Ghent (now at Western Reserve University, Cleveland); and "The Significance of the Egyptian Mummy," by Professor T. Wingate Todd, head of the department of anatomy at Western Reserve University Medical School.

At the Lowell Institute (Boston), on Tuesday and Friday evenings beginning Tuesday, December 5, a course of six lectures is being given by George Sarton, D.Sc., editor of *Isis* and lecturer on the history and philosophy of science at Harvard University. The course is on science and civilization in the time of Leonardo da Vinci, the titles of the lectures being:

1. "The Age of Leonardo."
2. "The Place of the Earth in the Universe."
3. "Geographical Discoveries."
4. "Progress in Physics and Chemistry."
5. "Progress in Biology and Medicine."
6. "The New Humanism."

Five lectures will be given at the Royal College of Surgeons of England in December by Dr. E. Mellanby, acting superintendent of the Brown Animal Sanatory Institution, on the part played in disease by water, salts and other simple substances.

The Swiney Lectures on Geology on "The Mineral Resources of Europe" have been delivered by Dr. J. S. Flett, at the Royal Society of Arts, London.

The Kelvin lecture was delivered before the Institution of Electrical Engineers, London, on November 9 by Dr. Alexander Russell, who explained how, in many fields of fundamental importance to the electrical engineer, Lord Kelvin's work had provided the basis on which his successors had built.

Frederick J. Hamilton Merrill, director of the New York State Museum from 1894 to 1904 and New York state geologist from 1899 to 1904, later a consulting geologist and mining expert in New York City, Arizona and California, died in Los Angeles on November 29, in his fifty-fifth year.

Newton B. Pierce, formerly plant pathologist for the U. S. government for the Pacific coast region, and more recently private collector and breeder of rare plants, died at his home in Santa Ana, Calif., the thirteenth of last October, aged sixty years.

Sir Hiram Stevens Maxim, the distinguished inventor, died in England on November 24.

Mr. Charles Smith, master of Sidney Sussex College, Cambridge and the author of works on mathematics, died on November 13, at the age of seventy-two years.

Professor H. M. Waynforth, until recently professor of engineering in King's College, London, died on November 5, aged forty-nine years.

Henrik Mohn, the distinguished Norwegian meteorologist, died on September 12 at Christiania, aged eighty-one years.

Members of Section E, Geology and Geography, of the American Association for the Advancement of Science, are requested to forward titles and abstracts of papers to be read at the New York meeting, to Dr. George F. Kay, Iowa City, Ia., not later than December 12.

The Sullivant Moss Society will hold its twelfth meeting on Friday, December 29, at Barnard College, Columbia University, in connection with the convocation-week meetings of the American Association for the Advancement of Science.

## UNIVERSITY AND EDUCATIONAL NEWS

Governor Edward F. Dunne and Dr. S. W. Stratton, director of the Bureau of Standards, are among the speakers that will give addresses on the occasion of the dedication of the new ceramics building at the University of

Illinois on December 6 and 7. Partly in connection with the exercises of the dedication of the new ceramics building, there will be held the annual session of the Illinois Municipal League, the 7th and 8th of December. University men giving addresses at this meeting will be Professor F. H. Newell, who speaks on "City Pavements"; Professor Edward Barton, on "The Latest Methods of Sewage Treatment"; Professor J. E. Smith on "Delays in the Execution of Public Works"; H. E. Babbitt on "Organization of Water Departments," and Professor J. M. Mathews on "Law Enforcement and Home Rule."

MRS. W. L. MARDSEN, of Seneca, Oregon, has given to the University of California extensive texts, grammatical notes and a vocabulary of the northern Piute language, recorded by her husband, the late Dr. W. L. Marsden. It is intended that these materials shall be edited by Professor A. L. Kroeber, for publication in the University of California publications in American archeology and ethnology.

WE learn from the *Journal* of the American Medical Association that Nielsine Nelson, the first woman physician in Denmark, bequeathed to the medical faculty of the University of Copenhagen three funds of 20,000 crowns each for scholarships for needy women medical students, and a further 50,000 crowns for the same purpose in the name of Ludvig Trier, a friend who had aided her and other students.

DR. GEORGE E. VINCENT, president of the University of Minnesota, has been appointed president of the Rockefeller Foundation, and will take up this work on May 15, 1917. He succeeds Mr. John D. Rockefeller, Jr., who will become chairman of the board of trustees, a newly created office. It will be remembered that Mr. Jerome D. Greene recently resigned the secretaryship of the board.

PROFESSOR ERNEST LINWOOD WALKER, of the University of the Philippines, has been appointed a lecturer on tropical medicine at the Harvard Medical School.

MR. W. L. DORAN, for the last two years graduate assistant in botany at the Massachusetts Agricultural College, has been appointed instructor in botany and assistant botanist at the New Hampshire Agricultural College and Experiment Station.

DR. ROY G. HOSKINS has been appointed associate professor of physiology in the Northwestern University Medical School.

## DISCUSSION AND CORRESPONDENCE

### OBSERVATIONS OF THE AURORA OF AUGUST 26 FROM BRITISH COLUMBIA AND ALASKA

SINCE the auroral display of August 26 has been reported from so many places I will take occasion to slightly extend the area over which it was observed by advising that it was a very conspicuous feature of the northern sky at Victoria, Vancouver Island, British Columbia. It was therefore observed from Atlantic to Pacific.

KAY ALEXANDER

November 15, 1916

I HAD an unusual opportunity for observing the auroral display of August 26, being at that time camped on the recently discovered Mount Alexander Mackenzie, on the crest of the Rockies of British Columbia in latitude 53° 57′, longitude 120° 27′.

Auroral displays are not unusual in this region even in summer, but the phenomenon of August 26 was by far the most brilliant and remarkable I have observed. It occurred at a very opportune time for me, as I was then returning after an exploration of the great west glacier. I got off the ice at 7:45 P.M., as the last rays of twilight faded; as I had still three miles to travel to camp, including the crossing of a steep 2,000 foot canyon, I was facing a chilly night under the stars, when quite suddenly the whole heavens became brilliantly illuminated and I was thus enabled to make the difficult climb back to camp.

The display began about 8:30 P.M. Pacific (120th meridian) time, with the formation of a bow of light in the north, surmounting a dark area which suggested the Crookes dark space in a vacuum tube. This increased in brilliancy and was supplemented by other irregular bows or bands of light, crossing the sky from east to west. These were the principal

sources of brilliant illumination, but in addition the whole sky, almost to the southern horizon, was swept with darting and shimmering beams and shafts and curtains of light.

I shall not attempt to rival the vivid description of Professor Nutting, for words fail to express the wonderful beauty and complexity of the display. One of the most striking features was the weaving of curtains of light, appearing as if composed of parallel shafts or filaments, which brightened and paled in waves passing sometimes in one direction and sometimes in the other. These waving curtains interweaved in the most marvellous fashion, sometimes two or even three distinct and overlapping motions being visible in the same area, the shafts of light appearing to glide to and fro like the figures in a complicated but tremendously silent dance.

A little later the display took on the most varied colors, though this phase of the phenomenon was comparatively brief.

The display ceased suddenly at about 9:45 P.M., just as I reached camp. Some of the bands were so brilliant and stable that I determined to try to photograph them. I went into the tent to get my camera and tripod and when I emerged not five minutes later the sky was nearly dark. Fred K. Vreeland

New York City,
November 15, 1916

It has seemed odd to me, a layman, that no scientist has yet reported to you the far western occurrence of the remarkable auroral display of August 26 last.

One year spent at Rampart on the Yukon about thirty-five miles south of the Arctic Circle had made me familiar with the varied manifestations of the aurora, its marvelously brilliant colors and the crepitation which occasionally accompanied them.

On August 26 I was hunting brown bear near Spass Kaia Bay on Chichagoff Island W. of 136° Long. and N. of 58° Lat. About 7:30 P.M. as nearly as I could guess, my attention was attracted by auroral streamers near the horizon. Looking up to the zenith the whole sky in every quarter was flooded and suffused with one of the most vivid and brilliant displays I have ever seen. The play of the glow and of the streamers was as rapid as that of heat lightning. The colors seemed to be of every shade of the spectrum. The play of the colors was the most remarkable manifestation to my mind, for they would alternately appear and disappear, the same streamer being full colored at one instant, gray and colorless the next, and colored full again. It is unusual to have so general and so vivid a display so far south even in Alaska, and the natives commented on the fact, saying it was a very rare occurrence and a sure sign of early sharp frost and winter. Erastus Brainerd

Seattle, Wash.,
November 21, 1916

I wish to add one more report to the long list already published, relating to the aurora of August 26. I was in Glacier Bay, Alaska, at the time, and saw a marvelous display on that evening. It began shortly after sunset, between eight and nine, Alaska time, when there was still considerable daylight in the sky. In its first appearance it was a sinuous band composed of pale green lances of light, seen first in the east, and winding over toward the west, fading into the still bright sunset light. This was shortly duplicated farther to the north; then four such bands were seen at once. Later, various colors appeared in rapidly changing sheets, working toward the zenith. The climax came with a great burst of color directly above us, almost like an explosion, but remaining in full brilliancy for at least some minutes, constantly changing with marvelous rapidity. The colors included purples, heliotrope, pink, light and dark green. This burst faded away, then repeated itself, and faded again. During the remainder of the evening the lights were pale and diffuse.

I have tried to deduce some general conclusions from the numerous reports that have appeared, with the following results. The aurora was visible over the whole of the northern two thirds of North America, the farthest stations reporting being Nova Scotia, Washington, D. C., Nebraska, Portland, Oregon and Glacier Bay. Plotting these stations on the

map, with whatever data concerning brilliancy and colors are available, the conclusion seems plain that the northern stations across the continent show the most variety in color. Reports from northern Michigan, Hector, B. C., and Glacier Bay indicate brilliant and varied colors, and these are the farthest north of stations reporting in their respective longitudes. Four others report less striking color effects: Ephraim, Wis., Lake Minnetonka, Minn., Beartooth Mts., Mont., and possibly Teton Co., Mont.; and all of these speak of pink or rose. All of those reporting from farther south mention or imply lack of color except the usual pale green. It appears therefore that variety of coloring increased northward. Another interesting point is that the display began everywhere at approximately the same hour, local time: that is, in the neighborhood of eight or nine P.M., or soon after sunset. Apparently then it moved westward across the continent, though it is barely possible that it merely became visible in each case with oncoming darkness. One or two of those reporting mention a streaming movement from east to west, which may or may not be of importance.

It is perhaps worth mentioning that during the week following August 26 two other auroras were visible, on August 30 and September 2. The latter was a very fine one—a bright greenish glow covering the whole northern sky almost to the zenith.

WILLIAM S. COOPER

MINNEAPOLIS, MINN.,
November 16, 1916

IT seems worth while to place on record the fact that the auroral display of August 26, 1916, recorded in so many parts of the continent, was especially brilliant at Juneau, Alaska. I noted it from about eight until after ten P.M. and was told by others that it continued until nearly midnight. It was the first one that I noted last summer, but I can not recall any of its details except that it was one of unusual brilliancy.

ALFRED H. BROOKS

WASHINGTON, D. C.,
November 13, 1916

I HAVE read with great interest, in the issues of October 20 and November 10, the letters recording the auroral display of August 26. I notice that the most western record, as given in SCIENCE, is from Collins, Washington, and the most northern one, in western North America, from the Selkirk Range in British Columbia. It may interest you to know that the auroral display on August 26 was a most magnificent one on the coast of Alaska. I was at the time a few miles south of Skagway, Alaska, and had an opportunity to witness the phenomenon in all its splendor. The display of all the colors of the spectrum rushing together from all directions into a gigantic whirlpool in zenith and then dispersing, lasted for at least half an hour. I may add that for a few days before the auroral display the electric conditions in the air were such as to render it almost impossible to use wireless telegraphy between points in Yukon and Alaska.

My colleague, Mr. H. T. Gussow, Dominion botanist, informs me that he witnessed a most brilliant auroral display on the 26th of August in the Straits of Georgia, between Vancouver Island and the mainland of British Columbia.

M. O. MALTE

CENTRAL EXPERIMENTAL FARM,
OTTAWA, CANADA,
November 13, 1916

## THE AURORAS OF 1859

So much has been said about the aurora of August 26 of this year that I have been thinking it might be well to make a note on the similar displays of August 28 and September 1, 1859, which few of the present readers of SCIENCE probably saw, but which seem to have been more splendid and remarkable. In both of these the streamers covered the whole sky, north and south, east and west, as seen from the Atlantic coast, in about latitude 43, where the present writer was then located, and converged to a point south and a little east of the zenith, indicating that they were in fact parallel to the dipping compass needle, the variation of which was a little west, for the north end.

In the display of August 28, they were of various colors; in that of September 1 they were of a uniform red. The brightness seemed to be about the same in both cases, and sufficient for one to read a printed page with ease. There was no moon. The southern streamers, especially, were very changeable; having continually many of what were then called "merry dancers," or rapidly changing clouds of light, among them. These displays, as it was noticed in the papers at the time, were visible as far south as Cuba; though of course they were not there so brilliant. They were accompanied by magnetic storms, and interference with telegraphic work.

The present writer was then engaged in astronomical observations, which had to be suspended during these illuminations.

Geo. M. Searle
Apostolic Mission House,
Brookland P. O., Washington, D. C.

## INFERENCES CONCERNING AURORAS

To the Editor of Science: I was much interested in the vivid description of the aurora of August 26 given by Dr. C. C. Nutting, followed as it was in the next issue of Science by a number of letters from different localities concerning the same, and I find in the last issue of Science, that of November 17, a most interesting account of this aurora, with general considerations respecting this phenomenon, given by Professor C. C. Trowbridge, of Columbia University.

Inasmuch as I had some time ago prepared a paper entitled "Inferences Concerning Auroras" for presentation at the meeting of the National Academy of Sciences in Boston, where the paper was read on November 14, it may be of interest to make a few brief statements concerning the inferences presented. In an address at the opening of the Palmer Laboratory of Physics at Princeton, entitled "Atmospheric Electricity" which appears in Science, N. S., Vol. 30, No. 781, pp. 857–869, December 17, 1909, I took occasion to state some opinions based upon the observation of auroras for many years, particularly as to the general relation of the auroral streamers to the earth. I quote the following statement:

> I have come to the opinion that the auroral streamers often extend in a general direction outwardly from the earth, sometimes for very great distances relatively to the known extent of our atmosphere. The effects observed appear unaccountable on any other supposition, while they are consistent with the idea of outwardly directed streams of great extent.

The evidence furnished by the recent aurora of August 26 confirmed the inferences which I had made many years ago, and added considerably to the possibility of applying certain ideas in explanation of auroral phenomena generally. In the paper before the National Academy I have, I think, established with a fair degree of certainty that the auroral streamers are in reality vertical or approximately vertical to the earth's surface. These vertical streamers appear in bands, more or less wide, in the general direction of parallels of latitude forming belts or zones in which the streamers extend upward, somewhat like trees in a forest. I find an explanation, also, of those auroras which appear to be limited to a narrow belt, and appear as a single narrow streak of light across the sky from east to west. There may be, of course, in any aurora, a number of such belts occupying different latitudes. I have endeavored to show, and I think successfully, that the curvature of the so-called auroral arch is a purely optical effect of perspective, increased somewhat by the curvature of the earth, and that the appearance of folded curtains of streamers merely means that the lower ends or feet of the streamers which are, with relation to the observer, of varying altitude, or are of varying latitude as in a belt which is of a winding nature.

It is pointed out, also, that the convergence of long streamers towards the zenith seen in the great auroras is purely an optical effect of perspective, and that the so-called zenith crown is, in reality, due to bundles of streamers nearly vertical like the others, but seen on end overhead.

There are a number of other inferences which are supported by the observations of Carl Störmer and others, among which is the probable existence of a conducting layer at a

height approximately fifty miles above the earth's surface.

It is expected that my paper will soon be published in the *Proceedings* of the National Academy of Sciences. In it the arguments are presented in full. ELIHU THOMSON

## A BUSINESS MAN'S APPRAISEMENT OF BIOLOGY

THE erection and dedication during recent months of important additions to the physical being of the Scripps Institution for Biological Research of the University of California has brought the name of the chief donor of money, Miss E. B. Scripps, quite conspicuously to public notice. Indeed so exclusively has the growth of the institution seemed in the eyes of the community to be the work of Miss Scripps that a brief statement of what has actually been and is going on here appears almost imperative not only to her but to all who have the welfare of the enterprise at heart.

In what follows I speak primarily in the interest of a department of the University of the State of California, the purpose of which is to investigate nature for the general good, and only secondarily in the interest of the particular persons who will figure in my remarks.

One of the most important secondary services a scientific research institution can render the public is in demonstrating that specialized and disciplined talent for studying nature, business experience and skill, and material wealth must be and can be brought together for the great task of making nature yield its best to the development of man's latent physical and spiritual capacities. A point needing emphasis just now is that no one who has grasped the full meaning of the task, and has had actual experience in it, can possibly raise the question as to which of these three factors is all-important—which is the "real thing" in the undertaking. All are absolutely indispensable, and debate on which is most important is scholastic folly. The reason for these remarks is the circumstance that the temper of the day makes the wealth factor appear to most eyes as the main one, the determining one, the one to which all the others are secondary. The prevalent theory that, after all, he who "holds the purse strings" is the real "power behind the throne" even in educational and scientific institutions, and so is the one to whom homage is chiefly due, is an embryonic trait, as biologists say, in the development of civilization —a trait to be left behind with advance toward adulthood. No one understands this better than do some of those who give large sums of money to public institutions. It does not disparage by one whit the importance of having large wealth and being willing to devote portions of it to the general good to point out that, as everybody knows who is acquainted with Miss Scripps, nothing could be more alien to her nature than to glory in the mere giving of a large sum of money toward the creation of an impressive physical structure dedicated to public use. Evidence that an "investment," be it large or small, contributes substantially to the general welfare, would give her supreme satisfaction, as this would be evidence not of mere ability to give, but to give *wisely*. In how far satisfaction of this sort is coming to Miss Scripps for what she has invested in this enterprise I do not know. I suspect there is still uncertainty in her mind; for the institution is too young to enable her to judge what service it may render.

But the personage primarily in view in this communication is not Miss E. B. Scripps, but Mr. E. W. Scripps. The truth is I am taking it for granted that Miss Scripps recognizes now the desirability of a kind of publicity concerning the origin and aims of the Scripps Institution not hitherto furnished, and that she would be willing to have me use her conception of an "investor" in behalf of the public as a starting point for what I am going to say about her brother. My words are addressed first and foremost to men of science, especially those who reflect on the larger human significance of material knowledge and the discovery of it.

The narration of a bit of personal-professional experience will be permissible, since it

will help to the end aimed at. Whether the Scripps Institution shall or shall not turn out to be useful to mankind, the foundational motive upon which it rests is a faith in the value of science, especially biological science, far more concrete and deep and broad than that which seems to be held by most men of science; and *this is in large measure due to E. W. Scripps.* I must explain. By native inclination the study of nature understood in much the sense of "the contemplation of nature" favored by naturalists a few generations ago, is to me one of the most exalting occupations the human mind can have. During the early part of my apprenticeship in science this feeling found great encouragement through the teachings and life of Joseph Le Conte, with whom at the University of California I came, as student and later as teacher, into close contact. Then there was a period of that intense specialization indispensable to progress in modern science, and with it the narrowing of interest and outlook and sympathy so likely to accompany such specialization. It was in this period of intensified specialization and concomitantly narrowed horizon that the early stages of development of the marine biological work which led to the present institution fell; and it was also in this period that my acquaintance with Mr. Scripps began. I saw him first in the summer of 1903, and the circumstances of the meeting were typical of my whole association with him. Our "marine laboratory" that year was a portion of the boat house on Glorietta Bite, Coronado, this space having been generously given us by the Coronado Beach Company. Mr. Scripps came on purpose to see what was going on, and the thing that especially struck me was his lively, pushing, obviously sincere interest in the details of our work. His visit was no mere hasty, listless walk through the room with a few more or less relevant remarks designed primarily to tell us in the least offensive way possible how really insignificant the whole thing was in his eyes. But with a sort of child-like eagerness he insisted upon being shown something about what each of the half dozen workers was doing. Here indeed was "something new under the sun"—at least to me. A man who, though the central figure in a great business, could yet drive twenty miles to visit a puny little scientific establishment and, though an entire stranger to such a place, could show an interest in not merely the enterprise but the actual work that was obviously genuine and, as to broad features, remarkably intelligent!

A part of my regular duty for a number of years had been to solicit private funds for our struggling enterprise and I had succeeded to some extent in interesting several men of large means in certain aspects of it, chiefly, perhaps, that of how to "let me down" with a minimum of disappointment to me and cost to them. But a few of these men had gone well beyond this and had shown real interest in the general idea of a marine laboratory and had done considerable work and promised to give substantial sums toward accomplishing the end. But never before had I found an interest that was not merely in the general idea or in me personally or professionally, but in science—in biology—*as such.*

Through the intervening years of association with Mr. Scripps, much of the time in the most intimate way, even as to the scientific work of the undertaking, not only have I never heard him so much as hint that any fragment of scientific knowledge or piece of research might be valueless, but his whole attitude and not infrequently his expression have been that of recognition of the inherent worth and dignity of natural knowledge, and most of all, of faith in science, especially, again, in biology, as the very foundation of rational human life in modern society. No scientific man, LeConte possibly excepted, with whom I have ever come in contact, has had so broad, so deep, so unfaltering and withal so intelligent a belief in the greatness and human worth of science, as Mr. Scripps.

Such a conception of nature, and of science as the rational interpretation of nature, held by a man endowed by birth with very unusual powers of mind, but, academically speaking, quite undisciplined in science, and eminently successful in business, has influenced my

thinking and estimates of value during the last decade beyond anything I can here tell. Enough to say that the scientific inquiry which has long been in the forefront of my interest, that namely of what the *real constitution of nature must be in order that it may include man in the full scope of his being,* has become wonderfully specific and real by having this remarkable subject under almost constant observation for so long a period. This perhaps more than any one factor has led me to conclude that the system of nature is, as by instinct almost Mr. Scripps appears to take it, much more intimately and vitally related to man than our modern philosophy or even our science usually recognizes.

Science has made great headway latterly in proving that man is a *part of nature;* but it has not done much toward understanding what nature is *because* man is a part of it.

The exceedingly unfortunate doctrine into which so much of western civilization has fallen, that everything about man which is esteemed supremely good is no part of his real nature but is supernatural (teaching of Christian theology) or is a by-product, an "epiphenomenon" (teaching of neo-Darwinian biology) nowhere finds more positive refutation than in such individuals as Mr. Scripps, whether we observe them as types of organic beings or consider their views about nature and science.

Such reflections have led me to endorse heartily his views that the human species taken exactly as it is and in the entire scope of its life, must be a subject for biological study; and to share his ambitions and intentions that the Scripps Institution shall after a while make some aspect of human biology thus conceived one of its departments of research. Those transcendent concerns of civilized man, the relation between the sexes, war, economics, patriotism, government, esthetics, ethics and religion, can never be treated with that freedom from prejudice and personal interest by which alone general truths can be rightly understood and appraised, excepting through the attainment of that attitude toward the tasks which characterizes the biologist in his dealing with problems of organisms inferior to man. This at least is the conviction we have reached after wide observation of instances and much theoretical discussion. And why in the nature of things should it not be possible to reach such an attitude toward the purely rational aspects of human problems? If man really is a part of nature, as biology confidently affirms that he is, how escape recognizing that if a bird's nest is a proper object for biological inquiry, an Eskimo's snow hut and a millionaire's palace are also? Or that if the mating antics of two spiders are biological phenomena, the Virginia reel and the tango are likewise? Or that if a bird chorus on a spring morning falls within the province of ornithological biology, a symphony concert falls within the province of anthropological biology? And it should be specially noticed that the fact that each of these sets of phenomena falls within the province of general biology does not by any means remove them from more restricted and specialized inquiry. The general biologist whose studies lead him to birds' nests or the courtship of spiders or the song of birds, not only is not disposed to supplant specialists in these subjects, but is led to recognize more than ever the importance and indispensability of their labors. Just as the general biologist who should come upon the subjects of social wasps or singing birds, could not do much without the help of specialists in these subjects, so the biologist who upon occasion should turn to social or musical humans, would be almost helpless without the aid of experts in human society and human music.

Much as we believe in the utility of biology to industry, hygiene, eugenics and the rest of man's material welfare, a thousand times more do we believe in its utility to his higher interests, especially just now when "Christian civilization" seems bent upon putting into practise the monstrously perverted biological theory of survival of the fittest, and destroying itself through military and economic war.

Concerning what Mr. Scripps's business experience and acumen have meant for the physical development of the institution, I will be

specific only with reference to two matters. First, that of the location of the institution. The idea of getting the present 177-acre site and of using it as it is being used originated with him and with him alone; and securing the land would have been impossible without him. But for his leadership in this we should now be in the little three-acre park in La Jolla. The enormous advantage of the present location as compared with the former one is becoming apparent to everybody connected with the institution. Second, the plan of having a business manager who alone should have charge of all monetary affairs of the institution. The wisdom and practicability of separating the business and scientific work of such an enterprise would seem so obvious that it is surprising that any other plan should be thought of except as a temporary makeshift. Yet the time and strength of many scientific men are consumed with business matters which their incompetence makes much more costly in time and money than the employment of a business manager would be.

The money, about $40,000 all told, "invested" in the enterprise by Mr. Scripps, though of very substantial aid in developing the "plant" and in maintenance, for which uses it has been given at different times and in varying sums, is of minor importance compared with the business experience and the ideas which he has contributed.

Wm. E. Ritter

Scripps Institution for Biological Research of the University of California, La Jolla, Calif.

### PSYCHOLOGY AS CONTRABAND

To the Editor of Science: Some weeks ago the State Department reported the seizure by the British government of a package of books sent from Germany through Holland to the Psychological Review Company. The president of the company, who is also editor of the *Psychological Review*, wrote to the American Consul General at London, stating that these books were scientific in character and essentially neutral. He suggested that the British authorities mention the titles and authors to any British psychologist and expressed confidence that any such expert would substantiate our statement.

The Consul General in due time replied that the British Procurator General had finally ruled that "such publications were not entitled to free transit."

The *Psychological Review* will not contest this decision in the British courts, but we wish to submit our case to the scientific world at home and abroad. Is there any good reason for hampering scientific progress by a policy of this sort? Would not the British psychologists do well to petition for a commission to determine the mental status of their Procurator General?

Howard C. Warren

Psychological Review Company, Princeton, N. J.,

November 15, 1916

## QUOTATIONS

### FOOD CONTROL

The decision of the board of trade, announced by Mr. Runciman on November 15, to appoint a food controller, has naturally excited a great deal of public interest, and more has been read into the announcement than it actually contained. The orders so far made by the board of trade under the Defence of the Realm Regulations apply to milk, flour and potatoes. The price of milk must not be raised above that paid at November 15, 1916, and the price may not exceed by more than a specified amount—in the case of retail milk 2d. a quart—the price in the corresponding month before the war. The order as to potatoes requires a return of potato stocks. The order which will have most effect in its influence on our daily diet is that which deals with flour. It affords an instance of how an agitation, unsuccessful in peace time, may succeed in its object under the stress of war conditions. The severe restriction of the hours during which alcoholic liquors may be sold, and the introduction of "summer time," or daylight saving, as it has been called, are other examples. The regulation prohibits for the future the production of any flour except such as would have been

called a few years ago, when there was a considerable agitation for its adoption, "standard flour."

The relative advantages and disadvantages of the grinding of wheat so as to produce a flour containing a larger proportion of germ and bran than the ordinary white flour have been somewhat fully discussed in our columns. The prevalent method, in consequence of the preference of the public for a very white flour and very white bread, has been to grind the wheat and separate the product into a succession of fractions, the principal fraction, white flour, forming about 70 per cent. of the grain. By arranging the milling in such a way that 80 per cent. instead of 70 is collected in one fraction, the amount of protein in the flour is substantially increased, and it has been claimed that the product is increased in nutritive value not only by the enhanced amount of protein, but by the retention in it of a larger proportion of the vitamines of the embryo. Mr. Runciman appears to have been impressed by this view of the matter as well as by the advantage of getting an additional yield. He stated in the House of Commons that the government had decided that 70 per cent. flour can not now be permitted in this country. "Pure white flour," he said, "from which has been abstracted, as some people think, some of its most valuable qualities, will not be milled in future. We shall retain in the flour a good deal of what I believe in some quarters is called offal and in others precious food." He went on to state that the percentage of wheat which should be converted into flour varied with different kinds of wheat, and that a scale of percentages would be laid down which would, on an average, raise the yield of flour about 8½ per cent. The milling order which has since been published gives the percentage of flour that must be extracted from wheat as varying from 73 to 78 per cent. according to the variety, the highest figure being that for Australian wheat; the average figure is 75 per cent., which is still well below the 80 per cent. which was the percentage adopted for giving "standard flour." Even the additional 5 per cent., however, represents a large increase in the amount of flour obtained from every sack of wheat. The palatability of the resulting bread will continue to depend chiefly on a judicious blending of flours and on good baking.

While there may still be some difference of opinion as to the extent of the advantage secured, there will probably be no difference of opinion in the medical profession on the point that it will, in the existing circumstances of the food market, be considerable, even apart from the fact that a given amount of wheat will yield a much larger proportion of bread than before. In this case, as in the case of "summer time" and other innovations, it will be interesting to see whether the general experience obtained will lead to the retention after the end of the war of what has been adopted as a temporary measure.—*British Medical Journal.*

THE decision of the government, which appears likely to result in the general consumption of "standard bread," will no doubt be received with varied feelings by various sections of the community. In view of the certainty that such differences of opinion are likely to arise, the following brief sketch of the facts of the case so far as they are known may be of general interest.

Under normal conditions at the present time the average practise of roller milling results in the recovery from cleaned wheat of rather more than 70 per cent. of its weight of flour, the remaining 28 or 29 per cent. of the wheat, consisting of various grades of "offals," being sold for feeding stock.

The changes announced last week would make it compulsory to recover 80 per cent. of flour from wheat, which would increase the amount of flour by about 8½ per cent. and decrease the amount of offals for stock-feeding by a like proportion, the percentage in both cases being calculated on the amount of cleaned wheat available for milling.

On the basis of the amount of flour produced in the United Kingdom for home consumption in the years immediately before the war, the change announced would increase the amount of flour available for bread-making by very nearly 600,000 tons, which would provide an extra 2-lb. loaf for every inhabitant of the

United Kingdom every three weeks, or seventeen extra 2-lb. loaves per head of the population per year. This is by no means a negligible increase in the bread supply, and it is doubtless considerations of this kind that have induced the government to take action.

If, however, we examine the result rather more closely, we find that the increase in the nation's food supply may not be so great as the above figures indicate. In spite of repeated statements to the contrary, bread made from 80 per cent. flour is not so nutritious, weight for weight, as bread made from 70 per cent. flour—at any rate, for the supply of protein and energy for the general population. Although 80 per cent. bread contains on the average rather more protein than 70 per cent. bread, the digestibility of the protein in the former is rather lower, so that the actual weight of protein digested by the average individual from 1 lb. of 80 per cent. bread is rather less than the amount digested from 1 lb. of 70 per cent. bread. Again, the energy value of 80 per cent. bread is rather lower than that of 70 per cent. bread. Still one more correction must be made in order to arrive at the actual increase in the national food supply which will result from the general adoption of a milling standard of 80 per cent. It is pointed out above that the recovery of 80 per cent. of flour from cleaned wheat entails a decrease in the supply of the finer wheat offals for stock-feeding to the extent of about 600,000 tons. These finer offals are largely used for feeding pigs. Their transference to human consumption would therefore decrease the production of pork and bacon, and this must be allowed for in estimating the total effect of the proposed alterations in milling. After applying all these corrections it appears that the general adoption of an 80 per cent. standard would undoubtedly give a substantial increase in the amount of digestible food for the supply of protein and energy for the population of the United Kingdom.

The possibility that the food value of bread would be substantially increased by the adoption of the 80 per cent. standard, because the content of the mysterious constituents known as vitamines would be increased by the inclusion of a greater proportion of the germ and of the outer layers of the grain, is perhaps scarcely worth discussing in this connection. Such constituents are supplied by other items comprised in an ordinary mixed diet, so that the vitamine content of bread can have little practical significance except in the very few cases where bread forms the whole, or very nearly the whole, of the diet.

The price of wheat offals for feeding stock is now so high that the adoption of the 80 per cent. standard can not be expected to make any considerable reduction in the price of bread. Even the compulsory admixture of a considerable proportion of other cereals, such as maize, oats or barley, with wheat for bread-making would not greatly cheapen the loaf, because these cereals are not very much cheaper than wheat. The important point in raising the milling standard and in including other cereals among the breadstuffs is that it would widen the sources from which the national food supply is derived—a most desirable end under existing conditions. To summarize, the result of a compulsory 80 per cent. standard would be neither better bread nor cheaper bread, but more bread.—*Nature.*

## SCIENTIFIC BOOKS

*The History of Melanesian Society.* By W. H. R. Rivers. Cambridge: The University Press, 1914. 2 vols. Pp. xii + 400 + 610.

Ethnologists have learned to rejoice at the sight of Dr. Rivers's name on the title page of an ethnological monograph. His work among the islanders of the Torres Straits stands as a model of painstaking research and critical method, originated in part by Dr. Rivers himself, while his elaborate study of the Todas of Southern India ranks with the best descriptive monographs of modern ethnology. In view of the author's methodological labors, moreover, one's anticipations are kindled as he glances through the pages of this newest attempt to reconstruct and interpret the history of an ethnographic district of which the cultural complexities have already taxed the ingenuity of Thilenius and

von Luschan, of Leo Frobenius, Graebner and Churchill.

The first volume of the book is wholly descriptive. It brings new data on the material culture and art, religion, ceremonial and social organization of several of the island groups of Melanesia. The data on social organization are particularly welcome, for they fill a long felt gap; unfortunately the author's own material also falls far short of being exhaustive; many details of the social systems described are lacking, nor are even the fundamentals always as definite as might be desired. Dr. Rivers, moreover, himself characterizes the descriptive part of his book not as an exhaustive treatise but rather as a preliminary survey. Further contributions covering the field are already announced: a volume on the Western Solomon Islands by Mr. A. M. Hocart and the author and a monograph by Mr. G. C. Wheeler on the islands of Bougainville Straits. Only one phase of his subject has Dr. Rivers covered almost exhaustively, the systems and terms of relationship together with the behavior of relatives. A valuable comparative list of terms used in the different island groups is appended to the first volume.

Of far greater significance and general interest is volume II. In it the author attempts a systematic albeit speculative reconstruction of Melanesian history. Whatever one may think of the author's conclusions, or even of his method, he deserves the highest credit for having conceived and carried out a logically coherent theoretical argument, at the hand of a multiplicity of concrete data, an argument which fills more than five hundred pages and, as an intellectual effort, stands unique in the whole range of ethnological literature.

In the first part of the volume the author uses the time-honored evolutionary method of historic reconstruction based on the theory of survivals. The fundamental assumption made by the author, which he uses as the cornerstone of the entire argument, is the basic and permanent character of social organization. This assumption is supplemented by the theory that the terms of relationship directly and faithfully reflect the social structure, particularly the forms of marriage. Operating with these hypothetical tools the author examines the morphology of the relationship systems of Melanesia and arguing from these to forms of social organization, particularly of marriage, he arrives at the earliest form (for the purposes of his argument, at least) of Melanesian society, characterized by a dual organization, maternal institutions, and a communism associated with a gerontocracy, the rule of old men, who tended to monopolize the women of the group and wielded undisputed authority in tribal affairs. During that remote period individual marriage gradually came into being and the relations of father and child became for the first time clearly defined. By argumentative steps which space forbids us to follow the author proceeds to carry Melanesian society through later stages, among these a totemic one, which, however, in some parts at least of Melanesia later again disappears, leaving no traces of its former existence.

The next move is a linguistic reexamination of the relationship terms of Melanesia, the result of which is a complete reinterpretation of the evolutionary process outlined above. For the author's comparative survey reveals two sets of terms: one set is very much the same linguistically in the whole of Melanesia, the other varies as one passes from island group to island group. The conclusion is that the uniform terms must belong to an ancient indigenous population, the diversified ones to a later people of immigrant origin. Thus is reached the conception of the cultural complexity of Melanesia. Follows an elaborate analysis of the secret societies of the island of Mota (Banks group). For reasons to be stated later the author ascribes these societies to an immigrant people, and detailed examination of the rituals of the societies provides a test for immigrant strata in Melanesian cultures. Supplementing this by a comparative study of methods of burial, the author finally resolves Melanesian culture into a series of strata: the most ancient culture of the dual people, followed by that of the kava people, followed by that of the betel

people. Last come certain recent influences from Micronesia and Polynesia. Polynesia, moreover, is made to participate in some of the other culture strata, so that a later Polynesian culture corresponds to an earlier Melanesian one, while the earlier Polynesian culture is given a share in the moulding of the culture of the dual people, which, therefore, also proves to be complex in character.

The remaining sections of the volume are devoted to an interpretation of the different aspects of Melanesian culture in the light of the cultural strata just outlined. Thus, linked totemism is regarded as due to two successive migrations of totemic peoples; conventionalized art is ascribed to the influence exerted by the geometrical art of one people on the realistic art of another; the origin of money is seen in the conditions which arise when two largely independent people live side by side; religion is a trait of the kava people, while the dual people were addicted to magic; sun and moon worship also come from the kava people, while stone work is due to ideas introduced by them; the bow and arrow belong to the kava as well as to the dual people, although they were subsequently lost among both; the plank-canoe was shared by the kava and betel peoples, while the dug-out originated with the dual people; the use of an inclusive and exclusive plural, finally, in some of the Melanesian languages points to the necessity of differentiating between two social strata.

In fairness to Dr. Rivers it must be said that the bare outline presented above does but poor justice to the author's amazingly complex argumentation. It will suffice, however, for the purpose of the present examination, which is not to refute the author—a task that would require a volume—but to characterize and expose his method. This restriction is the more justifiable as the author himself regards the "history" as a model of ethnological method.

In order to allow for a more deliberate analysis of the second part of Vol. II., the first part will be discussed very briefly. In it the author applies the method of survivals with little regard for probabilities. When a reconstruction based on a diagnostic utilization of relationship terms leads to the assumption of an ancient state of gerontocracy of a type hitherto unknown in concrete ethnographic experience, and of forms of marriage, such as that between individuals separated by two generations (a condition which, while it seems to occur, must certainly be regarded as highly exceptional), one pauses to think before accepting the author's conclusion. Again, although Dr. Rivers has certainly made good his contention that terms of relationship will reflect states of society, particularly of marriage—a position once held as a dogma by Lewis H. Morgan—and notwithstanding the new in part very striking evidence which the author's book brings in support of that contention, he clearly is guilty of deliberately overlooking the fact that social structure and function represent but two out of a set of factors which may and do influence relationship terms and systems. A set of terms must always remain a feature of language and as such it is subject to those influences which control linguistic changes as well as to the peculiar spirit of a particular language or linguistic stock. Again, a system of relationship, a set of terms, are phases of culture and, like other cultural features, they may spread from people to people, may be influenced by factors extraneous to the group to which they belong. While the theoretical validity of these propositions seems assured, one welcomes the fact that renewed interest in the numerous and intricate problems presented by the study of systems of relationship is manifested in a series of concrete and systematic investigations undertaken particularly by American anthropologists, investigations which have already brought valuable evidence in favor of a less one-sided attitude toward the problems of relationship systems and from which further results along similar lines may ere long be expected.[1]

But Dr. Rivers's principal error consists in

[1] *Cf.*, for instance, R. H. Lowie, "Exogamy and the Classificatory Systems of Relationship," *American Anthropologist*, Vol. 17, 1915.

the peculiar—one is tempted to say reckless—manner in which he applies the principle of the diffusion of culture in the second part of his theoretical argument. It is true, the author is not guilty of that mechanical handling of cultural features, like units of a physical mixture, which is so characteristic of Graebner's procedure. Dr. Rivers gives due weight to the psychological aspects of culture contact; he emphasizes, for instance, the observation that the very circumstances of the contact of two cultures may give rise to features foreign to both cultures before contact. He also devotes an entire chapter, perhaps the most valuable part of the volume, to an ordered consideration of the mechanisms and conditions, physical as well as psychical, of the diffusion of culture. But for all that the glaring unreality of the author's method remains the most striking feature of his book. Deliberately evading any attempt to furnish proof of diffusion in specific instances, the author erects a purely hypothetical structure, based on a bewildering maze of assumptions invariably favoring interpretations through diffusion while disregarding alternative interpretations. In the discussion of the secret societies of Mota, for instance, the author ascribes the secrecy of the societies, their multiplicity, as well as their grading in rank, to the fact that the societies were introduced by an immigrant people; they were secret because an open ritual in the presence of a hostile indigenous population (at another stage in the argument the population is assumed to be friendly to the newcomers) was dangerous; they were numerous because a constant stream of applicants for membership from the natives led to the formation of new societies; they were graded as to rank because a line had to be drawn between a society wholly of immigrant origin and one into which natives had already been admitted, and so on. Now, it is a well-known fact that religious societies such as those of Mota, whether they belong to other parts of Melanesia, to West Africa or to North America, are very commonly secret, multiple and ranked. No ground is found, in other places, to ascribe them to an immigrant people. Why, then, in Mota? The author is, indeed, aware of this circumstance. He admits the possibility of an alternative interpretation, but he rejects it in favor of his own, and proceeds with his argument (II., 213). Similarly, when discussing decorative art the author chooses to neglect the psychologically plausible and experientially verified tendency of designs to pass progressively from realistic forms to geometrical ones or of geometrical designs to become elaborated and often transformed through the addition of realistic appendages. For Dr. Rivers conventionalization is a factor "depending on the blending of peoples and of their cultures." By conventionalization he means "essentially a process by which a form of artistic expression introduced into a new home becomes modified through the influence of the conventions and long-established technique of the people among whom the new notions are introduced" (II., 383). The most striking instance of such procedure is perhaps the case of language, where the author ascribes the presence of the inclusive and exclusive plural to the necessity of differentiating between two classes of society. An inclusive and exclusive plural as well as dual occur, for instance, in quite a number of American Indian languages. In these instances Dr. Rivers himself would probably not find a sociological interpretation necessary. Why then so radical an assumption in the case of Melanesia, unless indeed it can be made something more than a mere assumption? An examination of several of the features used by the author as tests of his theory shows with great clearness how easy as well as futile it is to advance an interpretation of the facts through diffusion, unless proof can be furnished. We note a set of dual features: the sacred and the profane; higher and lower grades; chiefs and commoners; geometric and realistic designs; two communities with products to exchange; inclusive and exclusive plural; maternal and paternal descent; religion and magic. Now, it occurs at once that numerous instances could be cited where one or more of the

coupled traits coexist in the same community under conditions which preclude all possibility of ascribing one of the traits to an indigenous, the other to an immigrant culture. This being so, what justification is there for advancing such an interpretation in *any* case, unless the assumption can be supported by specific evidence? Obviously, the easier it is to explain a phenomenon in one of two ways, the more vigorous must be the proof if one of the two alternative explanations is selected.

After all, then, there is a close similarity between Rivers of the *Melanesian Society* and Graebner of *Die Melanesische Bogenkultur*. The former author takes special pains (II., 3, *seq.*) to assert his complete independence of Graebnerian method. That the author's position is in part justified, has been shown before. But in one respect the relationship of the two systems is unmistakable. Both authors utilize diffusion not as a process to be demonstrated but as one to be assumed for the purpose of hypothetical culture building. To be sure, what Rivers builds is altogether different from that which is built by Graebner, but the principles according to which the different parts of the structures are welded together are the same in either case.

Before closing it will be well to refer to Dr. Rivers's own definition of his method. We read:

> This method has been the formulation of a working hypothetical scheme to form a framework into which the facts are fitted, and the scheme is regarded as satisfactory only if the facts can thus be fitted so as to form a coherent whole, all parts of which are consistent with one another (II., 586).

The method, thus formulated, is, as a method of historical research, self-condemnatory. It may well be applied in the shaping of those hypothetical conceptual systems which are introduced by the theoreticians of the exact sciences for the purpose of providing a simplified description of the data of experience in a particular field. It does not matter how the vortex looks (or whether it looks at all), if only the functions of the ether can be readily derived from it. It may not be of importance whether the atom exists or not (with apologies to Lord Kelvin), but if it furthers a successful formulation of the facts of chemistry (a task in which of late it has conspicuously failed), its conceptual existence is vindicated. Not so in history. It has been said, with some truth, that for an understanding of society it is less important to know what has occurred than what may have occurred. But surely this does not apply to the study of history as such, nor to ethnology, in so far as its task is historical. Here the search is altogether for what has occurred, although the knowledge of what may have occurred can serve as a useful guide in the search. In the domain of ethnology, moreover, our knowledge of what has occurred will have to be increased many times before we can safely trust our intuitions as to what may have occurred.

To repeat, then, Dr. Rivers has labored fiercely against heavy odds, he has reopened an old and much trodden field; his work emphasizes once more the amazing cultural complexity of those southern seas; it is rich in subtle psychological analysis and happy formulation of theoretical principles; it also abounds in ingenious hypotheses of great *prima facie* plausibility. But we can not endorse this "history" as a model of ethnological method, for *a history* surely it is not.

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## SPECIAL ARTICLES

### LOBSTER MATING: A MEANS OF CONSERVING THE LOBSTER INDUSTRY

During the summer of 1914 the writer, working under the auspices of the Biological Board of Canada, attempted to rear lobster fry to the crawling stage, using the now familiar apparatus of the Rhode Island Commission. The site chosen for the repetition of the celebrated Wickford experiments was St. Mary's Bay, Digby Co., Nova Scotia. The attempt proved a complete failure due chiefly to the extreme cold water (50° F. to 60° F.) and to the extensive development of diatoms which soon closed up the mouth parts of the fry and caused an exceedingly high death rate.

However, an experiment that was at first supposed to be a very minor one compared with lobster rearing turned out to be the major one. It was this. About the middle of June, 47 females and 15 males (all known as "commercial lobsters," because the females when caught in fishermen's traps have no "berries" on them) were placed in a wooden pound enclosing an area of 10 feet by 20 feet. The slats of which the pound was built were about 4½ feet long, 3 inches wide and 1 inch thick. It was intended to retain the animals over winter for the purpose of elucidating the old question of whether or not adult females moult one year and extrude eggs the next, or whether they extrude eggs every year (when mating conditions are favorable) and only moult occasionally as they grow older.

On the 12th of August the whole of the 62 lobsters were dipped up to see what condition they were in. They all appeared healthy, and 36 per cent. of the females carried eggs. Dr. Herrick in his well-known book on the American lobster quotes from Vinal Edwards to the effect that the percentage of berried lobsters caught by fishermen off the Massachusetts coast was 12 per cent. for the autumn of 1893 to June 30, of 1894. Careful inquiries among both canners and fishermen of the St. Mary's area elicited the information that only about 1 per cent. of the females caught in fishermen's traps carried eggs. And then the question arose: How is it that in fishermen's traps only one female in every hundred carries eggs, whereas in our mating pen thirty-six out of every hundred carry eggs? The problem did not grow any simpler when it was found that by the end of September the percentage in our pen had risen to 64 per cent. The 17 females which did not extrude eggs were removed from the latticed pen and the 30 which bore eggs, representing the 64 per cent., were kept over winter in a compartment by themselves. On April 7, 1915, the 30 were all found to have the full complement of eggs upon them. Subsequently, in June and early July, they all hatched out their eggs, and being kept in compartments by themselves 9 of them were found to have extruded eggs in late July and August. These 9 were removed from the pen, the remaining 21 being retained, but unfortunately one corner of the enclosure gave way, allowing most of the 21 to escape and mingle with others, so that it was impossible to know how many more of them did extrude eggs.

Mating experiments were resumed during the summer of 1915, but were not so successful as those of 1914. Only 40 per cent. of the females extruded eggs, and the eggs were most of them unfertilized. Probably the sole reason for this was lack of males. During the early part of the summer we had only one male to mate with 51 females. Later on, we were fortunate enough to secure 25 more males, but half of these died from accidental poisoning by paint on the inside of our mating pens. Moreover, many of the remaining males were decidedly undersized—9½ to 10 inches in length. But perhaps the most fundamental reason for the poor showing of 1915 lay in the fact that the large majority of the females had been retained in the pound over winter, and as a consequence had suffered considerably in general health. Few of them had moulted and their "shells" were covered with dark brown algal growths that I have always seen upon lobsters when in lengthened confinement, but never upon those which were taken directly from the open sea.

In 1916 the Biological Board authorized an extension of the mating experiments to two other places on the maritime coast, namely, St. Andrew's, New Brunswick, and Pictou, on Northumberland Straits. The results to date are 25 "berried" out of 105 in St. Mary's Bay, 8 out of 22 at St. Andrews and 14 out of 21 at Pictou, or, expressed in percentages, 25 per cent., 36 per cent. and 66 per cent., respectively.

How do these percentages compare with the percentages of females caught in lobster traps in these same areas? Fortunately, through the courtesy of the Department of Naval Service, Ottawa, we were able to make a close approximation to an answer to this question. At the request of the Biological Board, the naturalist of the Fisheries Branch, Mr. Andrew

Halkett, was detailed to spend the summer in going out with lobster fishermen all around the coast, and in collecting statistics as to the total males, total females and percentages of berried females caught in lobster traps. The following is a copy of his summary of results:

| Date | Name of Place | No. Males | No. Females | No. Females which Carried Eggs | Remarks by Dr. Knight |
|---|---|---|---|---|---|
| April 24, 1916 | Tommy's Beach, N.S. | 56 | 58 | 0 | |
| April 25, 1916 | Tommy's Beach, N.S. | 26 | 27 | 0 | |
| April 28, 1916 | Little River, N.S. | 23 | 17 | 0 | |
| May 2, 1916 | Whale Cove, N.S. | 25 | 28 | 0 | |
| May 3, 1916 | White Cove, N.S. | 26 | 19 | 1 | Egg of 1915 |
| May 5, 1916 | Tiverton, N.S. | 9 | 20 | 0 | |
| May 15, 1916 | Lunenburg, N.S. | 36 | 35 | 1 | Egg of 1915 |
| May 17, 1916 | Port Mouton, N.S. | 50 | 39 | 3 | Eggs of 1915 |
| May 20, 1916 | Shag Harbor, N.S. | 46 | 54 | 0 | |
| May 22, 1916 | Shag Harbor, N.S. | 88 | 112 | 0 | |
| May 23, 1916 | Shag Harbor, N.S. | 39 | 70 | 2 | Eggs of 1915 |
| May 24, 1916 | Shag Harbor, N.S. | 171 | 158 | 0 | |
| May 26, 1916 | Cape Sable Island, N.S. | 68 | 98 | 0 | |
| May 30, 1916 | Lobster Bay, West Pubnico | 82 | 73 | 0 | |
| June 2, 1916 | Cape St. Mary's, West Pubnico | 66 | 86 | 0 | |
| June 6, 1916 | Mink Cove, N.S. | 34 | 25 | 1 | Egg of 1915 |
| June 10, 1916 | Little River, N.S. | 24 | 28 | 0 | |
| June 12, 1916 | Little River, N.S. | 14 | 10 | 0 | |
| June 15, 1916 | Ostrea Lake, N.S. | 16 | 14 | 0 | |
| June 16, 1916 | Jeddore, N.S. | 169 | 191 | 6 | Saw first eggs hatching 1915 |
| June 20, 1916 | Pope's Harbour, N.S. | 6 | 6 | 0 | |
| June 24, 1916 | Pugwash, N.S. | 366 | 352 | 50 | 9/10 old, 1/10 new eggs |
| June 28, 1916 | Skinner's Reef, N.S. | 56 | 36 | 1 | Egg of 1915 |
| June 29, 1916 | Pictou Island, N.S. | 24 | 39 | 1 | New eggs (1916) |
| July 10, 1916 | Northport, N.S. | 111 | 110 | 10 | 9 old eggs, 1 new |
| July 13, 1916 | Shemogue, N.B. | 108 | 95 | 3 | 1 egg 1915, 2 new |
| July 17, 1916 | Dupin's Corner, N.B. | 50 | 27 | 1 | Egg 1916 |
| July 19, 1916 | Cormierville, N.B. | 133 | 105 | 0 | |
| July 20, 1916 | Chockfish River, N.B. | 139 | 119 | 1 | Eggs new |
| Aug. 1, 1916 | Cape Traverse, P.E.I. | 157 | 158 | 1 | Eggs new |
| Aug. 2, 1916 | Cape Traverse, P.E.I. | 134 | 112 | 2 | Last eggs seen hatching |
| Aug. 4, 1916 | Brae Harbour, P.E.I. | 164 | 108 | 1 | New eggs (1916) |
| Aug. 5, 1916 | Rocky Point, P.E.I. | 135 | 77 | 1 | New eggs (1916) |
| Aug. 7, 1916 | Brae Harbour, P.E.I. | 207 | 118 | 3 | New eggs (1916) |
| Aug. 9, 1916 | West Point, P.E.I. | 325 | 274 | 5 | New eggs (1916) |
| Aug. 10, 1916 | Brae Harbour, P.E.I. | 150 | 100 | 3 | New eggs (1916) |
| | Totals..... | 3,333 | 3,004 | 97 or 3.2% | |

Samples of all eggs were sent to me for the determination of the age of the eggs.

Let us compare these results with statistics furnished me by Dr. Hugh M. Smith, the fish commissioner at Washington, as to the number of lobsters taken off the Massachusetts coast.

Dr. Smith is careful to state that the number of berried females is probably understated, because of the carelessness of fishermen in making returns. We are quite certain that the percentages for 1894–95 are too low, because we have Vinal Edwards's catch off Woods Hole already referred to for these same years, showing 12 per cent. of the females as carrying eggs. Does this mean that 88 per cent. of the female lobsters off the Massachusetts coast are sterile? If female lobsters moult every second year and extrude eggs in the alternate years, why do not 50 per cent. of them carry eggs? But they do not, as every fisherman knows.

The fact is that the biennial theory of moulting and spawning can not be held any longer. In the sixties and seventies when about half the females carried eggs (see Vinal Edwards quoted by Herrick in regard to 63.7 per cent. of the females off No Man's Land being ber-

ried) the theory seemed to fit the facts. Today it does not.

| Year | No. Lobsters Above 10½ Inches | Egg-bearing Lobsters | Estimated Females—about Half the Total | Percentages of Berried Females |
|---|---|---|---|---|
| 1888 | 1,740,850 | .... | ..... | |
| 1889 | 1,359,645 | 61,832 | 679,823[1] | 9 per cent. berried |
| 1890 | 1,612,129 | 70,909 | 806,065 | |
| 1891 | 1,292,791 | 49,973 | 646,395 | |
| 1892 | 1,107,764 | 37,230 | 553,887 | |
| 1893 | 1,149,732 | 32,741 | 579,866 | |
| 1894 | 1,096,834 | 34,897 | 548,467 | 6 per cent. nearly |
| 1895 | 956,365 | 34,343 | 478,187 | 7 per cent. nearly |
| 1896 | 995,396 | 30,470 | 497,698 | 6 per cent. nearly |
| 1897 | 896,273 | 23,719 | 498,186 | |
| 1898 | 720,413 | 19,931 | 360,206 | |
| 1899 | 644,633 | 16,470 | 322,316 | |
| 1900 | 646,499 | 15,638 | 323,299 | |
| 1901 | 578,383 | 16,353 | 289,190 | 5 per cent. |
| 1902 | 670,245 | .... | 335,127 | |
| 1903 | 665,466 | .... | 332,733 | |
| 1904 | 552,290 | 13,950 | 276,145 | |
| 1905 | 426,471 | 9,865 | 213,235 | 4.6 per cent. |
| 1907[2] | 1,039,886 | 10,348 | 519,943 | 2 per cent. |
| 1908[2] | 1,035,123 | 9,081 | 517,561 | |
| 1909[2] | 1,326,219 | 11,656 | 663,109 | |
| 1910[2] | 935,356 | 7,857 | 467,678 | 1.6 per cent. |

The question to be answered is this: How is it that off the Massachusetts coast in 1910, only about 2 per cent. of the females carried eggs? Even if the figures are not absolutely correct, the general falling off in percentage since 1888 is most marked. In Canada, we have collected no statistics until this year (1916), and Mr. Halkett's returns show that an average of about 97 per cent. carry no eggs. Are these females all sterile? Impossible belief!

For the Canadian coast, therefore, it is clear, that the percentage of females which carry eggs in traps varies from less than 1 per cent. in the Bay of Fundy area (which may be said to include St. Mary's and St. Andrew's) to about 4.2 per cent. in Northumberland Straits; whereas, by mating experiments in these same areas the percentages are increased by an average of 3,000 per cent. in the former and 1,600 per cent. in the latter area.

[1] The estimate of females, as half of the totals is mine.—A. P. K.

[2] Number of lobsters above 9 inches.

Early in our experiments this summer the possibility occurred to me that females in the open sea might in autumn carry more eggs than they do in spring and early summer. In other words, many females might for one reason or another lose their eggs during the winter, and thus reduce the percentage to that elucidated by Mr. Halkett. This possibility was tested to some extent during August and September (1916). Through the courtesy of the Minister of Fisheries, the Hon. J. D. Hazen, I was permitted to fish for lobsters from August 19 to August 31, and found the percentage to 2½ per cent. for the Pictou area. Fishing was again resumed during the last four days of September, when the percentage was found to have increased to 5.6 per cent. Moreover, during September we had 25 males and 25 females confined in the mating pen, and although the enclosure gave way at one corner and allowed some of the lobsters to escape, nevertheless 13½ per cent. of the females were found to have extruded eggs. Here the increase by mating is quite clear.

While I dislike theorizing at this stage in the experiments, I may be permitted to suggest that probably the majority of female lobsters extrude their eggs every year; but that as the total males and females are now greatly reduced through overfishing, and relatively widely separated from each other in the open sea, there is less copulation than formerly, with consequent lack of fertilization of eggs. Being unfertilized the eggs soon "go bad," and drop off. On the other hand, mating brings the sexes together with a resulting increase in the numbers of females carrying fertilized eggs.

We may safely conclude, therefore, that the efficacy of mating as a means of increasing the number of berried females is fairly well established, on the supposition, of course, that the catch of berried females fairly represents the number of berried females in the bottom of the sea. At any rate, the results amply justify further experiments on a large scale, and if further results prove as successful as those of the past three years, they far surpass the results of either lobster hatching or lobster

rearing as a means of conserving the lobster industry.

A. P. Knight

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## THE ROYAL SOCIETY OF CANADA

The thirty-fifth meeting of the Royal Society of Canada was held, this year, in the Chateau Laurier at Ottawa, Province of Ontario, under the presidency of Professor Alfred Baker, M.A., LL.D., of Toronto University. There was a large attendance of fellows from all the provinces of the Dominion. As is well known to readers of Science, this society is essentially national in character; and in the four sections into which the society is divided, the archeological, literary, historical as well as scientific leaders in thought, of English as well as of French Canada, are represented. The society meets but once a year in conclave, but sections can be called at the bidding of its officers to carry out programs of lectures, reading of papers or similar functions with a view of furthering the aims of the society.

Seventeen affiliated societies of Canada reported through their official representatives or delegates. The war now raging in Europe has affected the society to a marked degree, not only in the attendance at the annual meeting owing to the number of fellows serving at the front, but also in the distribution of the publications. There was no distribution to enemy countries.

Death has removed several fellows, including Sir Sandford Fleming; Dr. W. F. King, astronomer; Dr. Samuel E. Dawson, littérateur, historian and geographer, and Monsieur Ernest Gagnon, historian.

The third and fourth sections of the Royal Society of Canada are those specially devoted to the sciences, and papers were presented and read which cover the wide field of research common to all nationalities and special interest to readers of Science.

*List of Papers presented in Section III, Chemical and Physical Sciences*

Presidential address. By Dr. F. T. Shutt, M.A., F.I.C.—"Agricultural Research in Canada."

"The Turn of Tidal Streams in relation to the Time of the Tide," by W. Bell Dawson, M.A., D.Sc., M.Inst., C.E., F.R.S.C.

"The Smelting of Titaniferous Iron Ores," by Alfred Stansfield, F.R.S.C., D.Sc., A.R.S.M., professor of metallurgy, McGill University, and William Arthur Wissler, M.Sc., of McGill University.

"Factors connecting the Concentration and the Optical Rotatory Power of Aqueous Solutions of Nicotine," by Alfred Tingle and Allan A. Ferguson. Presented by Professor W. R. Lang, F.R.S.C.

"A New Method for the Determination of Nicotine in Tobacco," by Alfred Tingle and Allan A. Ferguson. Presented by Professor W. R. Lang, F.R.S.C.

"The Influence of Fertilizers on the Flow of Water through Soils," by C. J. Lynde, Ph.D., professor of physics, and R. Dougall, B.S.A., research assistant under the Dominion Grant for Agriculture, Macdonald College, P. Q. Presented by Dr. H. T. Barnes, F.R.S.

"On the Initial Charged Condition of the Active Deposits of Radium, Thorium and Actinium," by G. H. Henderson, B.A., B.Sc., instructor in physics, Dalhousie University. Presented by H. L. Bronson, F.R.S.C.

"The Structure of Hailstones of Exceptional Form and Size," by Francis E. Lloyd. Presented by Professor C. H. McLeod, F.R.S.C.

"Human Adipocere," by R. F. Ruttan, M.D., F.R.S.C.

"Formation of Ring Ice or Hoar Frost in Pipes," by Professor H. T. Barnes, F.R.S.C.

"Contact Resistance in Oil," by H. E. Rielley, M.Sc., and Violet Henry, M.Sc. Presented by Professor H. T. Barnes, F.R.S.C.

"The Contact Resistance between Conductors in Relative Motion," by Violet Henry, M.Sc. Presented by Professor H. T. Barnes, F.R.S.C.

"The Solubility of Aluminium Hydroxide in Solutions of Ammonia," by E. H. Archibald and T. Habasian. Presented by Professor Ruttan.

"The Occlusion of Iron by the Ammonium Phosphomolybdate Precipitate," by E. H. Archibald and H. B. Keegan. Presented by Professor Ruttan.

"A Comparison of Radium Standard Solutions," by J. Moran. Presented by Professor A. S. Eve, F.R.S.C.

"The Release of Radium Emanation from Water at Different Temperatures by Bubbling Air through the Solution at a Uniform Rate," by J. Moran. Presented by Professor A. S. Eve, F.R.S.C.

"The Double Salts Formed by Sodium and Potassium Carbonates," by J. W. Bain, F.R.S.C., and C. E. Oliver.

"On the Effect of Stationary Sound Waves on Viscous Flow in Pipes and Channels," by Louis Vessot King, M.A. (Cantab.), D.Sc. (McGill), F.R.S.C., associate professor of physics, McGill University, Montreal.

"Concerning a Certain Non-involutory System of Partial Differential Equations," by C. T. Sullivan, lecturer in mathematics, McGill University, Montreal. Presented by Jas. Harkness, F.R.S.C.

"The Algebraic Basis for Two Formulæ in the Theory of Expansions according to Bessel Functions," by James Harkness, M.A., F.R.S.C.

"Alternate Number Indices in Triangular Coordinates," by J. C. Glashan, LL.D., F.R.S.C.

"On the Scattering and Attenuation of Radiation in the Solar Atmosphere," by Louis Vessot King, M.A. (Cantab.), D.Sc. (McGill), F.R.S.C., associate professor of physics, McGill University, Montreal.

"On Boundary Conditions in the Dynamical Theory of Gases," by Louis Vessot King, M.A. (Cantab.), D.Sc. (McGill), F.R.S.C.

"Progress on 72-inch Reflecting Telescope," by Dr. J. S. Plaskett, F.R.S.C., Dominion Observatory, Ottawa.

"Hygrometry," by A. Norman Shaw, B.A. (Cantab.), D.Sc., Macdonald College, McGill University. Presented by Professor H. T. Barnes, F.R.S., F.R.S.C.

The important question of industrial research introduced by the president, was very thoroughly discussed at two sessions of the Section and various opinions as to the best methods of procedure were advanced. The following resolution which was adopted represents the final conclusion arrived at by the members of Section III.:

"WHEREAS, it is important that the scientific forces of Canada should be organized to aid in the vigorous and efficient prosecution of the war and in the development of Canadian industries to meet the present conditions as well as those which may prevail after the war,

"*Resolved* that the Royal Society of Canada respectfully suggests to the government the appointment of a committee or commission of scientific men whose duty it shall be to advise the government how best to utilize the men and laboratories available for such purposes."

The commemoration of the 50th Anniversary of Confederation was decided to be marked, at the meeting of 1917, by historical papers dealing with the progress of the various divisions of mathematical and physical sciences. The officers of the Section were asked to select the members who would prepare such papers.

The election of officers for Section III. resulted in the choice of the following:

*President*—R. F. Ruttan, M.D., C.M., D.Sc.
*Vice-president*—A. S. Eve, D.Sc.
*Secretary*—F. T. Shutt, M.A., D.Sc.

Progress was reported on the 72-inch reflecting telescope now approaching the final stages of erection and adjusting at the Dominion Observatory at Ottawa, Canada.

SECTION IV. (GEOLOGICAL AND BIOLOGICAL SCIENCES)

This section reports five sessions under the chairmanship of Mr. J. B. Tyrrell, M.A., F.G.S.

Twenty-nine fellows were in attendance as follows: Messrs. Adams, Bailey, Bethune, Brodie, Buller, Coleman, Dowling, Dresser, Faribault, Faull, Grant, Harrison, Hewitt, Huard, Lambe, Macallum, Mackay, McConnell, McInnes, McMurrich, Matthew, Moore, Parks, Prince, Tyrrell, White, Harris, Hunter and Lloyd. Four absent Fellows are on active service: Dr. Adami, Dr. Harrison, Dr. MacKenzie and Dr. Nicholls.

To the membership were added the names of Professors Harris, Hunter, Lloyd and Fraser.

The following officers were chosen for the year 1916–17:

*President*—J. P. McMurrich, F.R.S.C.
*Vice-president*—R. G. McConnell, F.G.S.
*Secretary*—J. J. Mackenzie, F.R.S.C.
*Acting-Secretary*—J. H. Faull, F.R.S.C.
*Publication Committee*—Dr. Hewitt, Mr. Dowling and Dr. Harrison.

*List of Papers Presented in Section IV*

Twenty-one papers, a list of which is appended, including a presidential address of much interest on "Notes on the Geology of the Nelson and Hayes River, Manitoba," were presented to the Section, contributions in the gross that represented a large amount of important and stimulating work.

Presidential Address—"Notes on the Geology of the Nelson and Hayes River, Manitoba," by J. B. Tyrrell, F.R.S.C.

"Notes on the Plankton of the British Columbia Coast," by J. Playfair McMurrich, F.R.S.C.

"On a New Anthomedusan from the Coast of British Columbia," by H. B. Bigelow. Presented by Professor McMurrich, F.R.S.C.

"The Quantitative Study of Climatic Factors in Relation to Plant Life," by J. Adams, M.A. Presented by C. Gordon Hewitt, D.Sc., F.R.S.C.

"Geologic Range of the Phyla, Classes, Subclasses and Orders of the Plant and Animal Kingdoms," by Lancaster D. Burling. Geological Survey, Canada. Presented by Lawrence M. Lambe, F.R.S.C.

"Ganoid Fishes from near Banff," by Lawrence M. Lambe, F.R.S.C., F.G.S.A., vertebrate paleontologist to the Geological Survey, Canada.

"Achondroplasia, a Problem in Development," by Albert G. Nicholls, M.A., M.D., Sc.D.

"Studies on a Timber Destroying Fungus—*Fomes officinalis*," by J. H. Faull, Ph.D., F.R.S.C.

"Notes on Cambrian Faunas," by G. F. Matthew, LL.D., D.Sc.

"Studies on the Protozoan Parasites of the Fishes of the Georgian Bay," by J. W. Mavor, B.A., Ph.D., University of Wisconsin, Madison, U. S. A. Presented by E. E. Prince, LL.D., F.R.S.C.

"Statistical Studies on the Growth of the Pollock, Haddock and Hake," by J. W. Mavor, Douglas Macallum and Dorothy Duff; with twenty figures. Presented by E. E. Prince, LL.D., F.R.S.C.

"The Abscission of Flower-buds and Fruits in its Relation to Environmental Changes," by Professor Francis E. Lloyd, F.R.S.C.

"On the Development of *Æquorea forskalea*," by C. McLean Fraser, Ph.D., F.R.S.C.

"Bibliography of Canadian Botany for the Year 1915," by A. H. MacKay, LL.D., F.R.S.C.

"Bibliography of Canadian Entomology for the Year 1915," by C. J. S. Bethune, D.C.L., F.R.S.C.

"Bibliography of Canadian Zoology for 1915 (exclusive of Entomology)," by E. M. Walker, B.A., M.B., F.R.S.C.

"Bibliography of Canadian Geology for the Year 1915," by Wyatt Malcolm. Presented by R. G. McConnell, B.A., F.R.S.C.

"Some Further Observations on the Discharge of Spores in the *Uredineæ*," by Professor A. H. Reginald Buller, F.R.S.C.

"Upon the Germination of the Spores of *Coprinus Sterquilinus*," by Professor A. H. Reginald Buller and S. G. Churchward.

"Structure of the Basin of Lake St. John," by J. A. Dresser, F.R.S.C.

"Dysentery, and the Dysentery Bacillus. A Report of some Cases with Isolation of Organisms of the Shiga Group," by R. F. Kelso, M.D., and W. Sadler, B.S.A.

### GENERAL NOTES

The council of the society recommended to the various sections the advisability of suitably commemorating the 50th anniversary of confederation of the various provinces of British North America by preparing papers dealing with the progress of literature and science in Canada during this period. Action on the part of the sections followed.

The presidential address by Professor Baker, of Toronto University, was entitled "Canada's Intellectual Status and Intellectual Needs."

In this address the retiring president, Dr. Baker, discussed the educational problems of the various provinces of all Canada, of native born and also those of European birth. The writer argued for an increased study of the French language, and then turned his attention to the press, the public libraries and to technical education as well as education in agriculture for the Dominion.

Museums, as factors in modern civilization, were also discussed, including art museums. Canadian literature, agricultural research, the work of the Biological Board of Canada, and general scientific research, on the lines of the Carnegie Institute, followed together with the work of the Rockefeller Institute and similar institutions in the United States that make for the benefit of humanity as a whole. Professor Baker paid a glowing tribute to the benefactors in the United States who by endowments and munificent donations, had done so much to increase our knowledge in so many directions, thus raising the status of research work to such a pitch that the summit or center of gravity of scientific discovery in this world may soon be found in the Republic of our neighbors.

The officers for 1916–17 are as follows:

*Hon. President*—His Grace the Duke of Devonshire, Governor-General of Canada, etc.

*President*—Professor A. B. Macallum (Toronto, Ont.).

*Vice-president*—His Honor Mr. Justice J. W. Longley.

*Hon. Secretary*—Mr. Duncan C. Scott (Ottawa, Ont.).

*Hon. Treasurer*—Dr. C. Gordon Hewitt.

*Hon. Librarian*—Mr. D. B. Dowling.

Amongst the other papers read before Section II., not included in the foregoing, of special interest in geography, archeology, ethnology, etc., may be mentioned the following:

1. "Place Names in the Southern Rockies," by James White, F.R.G.S., Canadian Commission of Conservation (Ottawa).

2. "Signposts of Pre-historic Time," by W. D. Lighthall, M.A. (Montreal).

3. "An Organization of the Scientific Investigation of the Indian Place-Nomenclature of the Maritime provinces of Canada" (sixth paper), by Professor W. F. Ganong, M.A., Ph.D.

4. "The Refugee Loyalists of Connecticut," by Professor W. H. Siebert, of the Ohio State University.

H. M. Ami

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